UNIVERSITY OF PENNSYLVANIA

RATE OF PROGRESS AND THE IQ

W. WALKER CHEYNEY

A THESIS

IN EDUCATION

PRESENTED TO THE FACULTY OF THE GRADUATE SCHOOL IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY

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TABLE OF CONTENTS

I

PAGE

INTRODUCTION

The Purpose of the Study 7
The Statement of the Problem 8
The Statistical Problem 9
Checks Upon the Statistical Procedure 9
Factors Which Will be Considered 9

II

COLLECTION AND ANALYSIS OF THE DATA

Preliminary Studies and Investigation of Previous Research 11
Collecting the Data 13
Selecting the Grade 14
The Schools Studied 14
Neighborhoods 14
Nativity of the Parents 14
Percentages of Promotion 15
Per Cents of Failures 15
Comparison of Mental and Educational Age Medians with National and State Norms 16
Distributions of MA, EA, CA, IQ and EQ 17
Data Obtained 18
Validity and Reliability of the Otis Classification Test 19
Scoring the Tests 20
Tabulating the Data 20
The Effects of Errors in the Data 20
The Analysis of the Data 21

III

THE RELATION BETWEEN THE RATE OF PROGRESS THROUGH THE GRADES AND THE INTELLIGENCE QUOTIENTS OF THE PUPILS 22
Part I. Rate of Progress and the IQ 22
The Rate of Progress Criterion 23
The Reliability of the Criterion 25
The Reliability of the Determination of the Intelligence Quotients 26
Summary of Corrections to be Made to Obtained Coefficient 28
Correlations Between Rate of Progress and Intelligence Quotients 28
True Correlations Between Rate of Progress and Intelligence Quotients 30

The Method of Changing a Correlation to a Percentage Value..... 31
Finding the Percentage Value for a Factor by the Normal Curve Probability Method..... 38
Part II. Teachers' Reasons for Failure..... 43
Part III. Analysis of Cases Which Deviate from the Regression Line.... 50
Part IV. Chances of Avoiding Retardation with Given IQ's..... 53
Part V. Summary..... 54

IV

The Relation Between the Rate of Progress Through the Grades and Factors Other than the IQ..... 56
Sex Differences..... 57
Factors Related to the Home Environment:
The Decease of One or Both Parents..... 59
Foreign Parentage..... 59
Reading Quotient..... 61
Occupations of the Fathers..... 62
Future Plans of the Pupils..... 63
Studying in a Room by Oneself..... 66
Number of Other Children in the Family..... 67
Age at Entrance to Grade 1A..... 68
Changes from School to School..... 69
Counselor's Ratings of Home Conditions
Total Home Conditions..... 69
Physical Home Conditions..... 71
Effort on the Part of the Pupil
Teachers' Estimates..... 72
The Relation Between the EQ and the IQ..... 75
Physical Condition of the Pupils
Absences..... 77
Physical Defects..... 79
Physical Education Records..... 81
Summary..... 82
Conclusions..... 83

V

Conclusions..... 84

VI

Implications of the Study..... 88

BIBLIOGRAPHY..... 93

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I

Introduction

The Purpose of the Study

One of the characteristics of present-day educational philosophy is the study of the individual child with a lively interest in his problems, his hopes and his fears. And yet in the public schools of America there are, each year, hundreds of thousands of pupils who fail to such an extent that pride in achievement and hope for success in school life must be presumed to be almost destroyed.

Sometimes the tragedy of an individual failure is brought closely home to a teacher but usually he does not attempt to penetrate too deeply into the troubles of a little child's mind. In thinking of the hundreds of children who succeed, he tries to forget the scores of children who fail. If he succeeds in promoting about ninety per cent of his pupils he is likely to be satisfied.

From time to time, however, individual educators do come to realize the futility of our present system of branding certain children as failures,[1] and to comprehend the misery and the lack of confidence which it burns into the nervous systems of its victims. But whether these individuals be teachers or superintendents of schools they are caught alike in the inexorability of the vastness of the public school system. The former do not have the power to effect widespread improvements and the latter do not have sufficiently definite data upon which to recommend radical changes in procedure.

As a result of this difficult situation practical school men have been forced by the natural functioning of their defensive reflexes

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[1] Terms such as "failure" and "success" are used in a generic sense. The term "rate of progress" is used in a specific sense, as defined on page 24. In general it may be said that the concept of "failure" is from the child's point of view, rather than from the point of view of educational proficiency as measured by achievement tests.

into a fatalistic attitude in regard to the question of school failures. Whatever action they undertake usually has for its objective a reduction in the percentages of failure rather than the complete eradication of it.

It is not reasonable to believe, however, that this attitude of partial helplessness will persist beyond the day when the relative importance of the factors related to failure will have been definitely determined and understood. It is the purpose of the present analysis to study this problem of school failure in such a way that it will add some contribution to the determination and understanding of the relative importance of these factors.

There have been many studies of this and related topics, but some of these have been comprehensive without being objective, while others have been objective without considering all of the factors which may be involved. It is felt that there is need for a study which will present and analyze a more comprehensive assembling of objective evidence in concrete form where it may be criticised and the truths and fallacies of its implications definitely determined.

The Statement of the Problem

While the primary purpose of this study is to find the factors related to failure, whatever they may be, a study of the most objective of the previous studies on this problem and the preliminary investigations of this study itself have developed the probability that the most important factor in failure is the lack of a sufficiently high degree of what is called "Intelligence."[2] It seems advisable, therefore, to devote a major portion of this study to the determination of the extent to which intelligence is a factor in success or failure. The problem may be stated in the form of a question:

"To what extent is intelligence the chief factor in the rate of progress of pupils from the first grade to the end of the eighth grade[3] of a large city school system, and to

[2] See page 12 reference 4 and page 13 references 5 and 6.

[3] This study includes only those pupils who have persisted in school to the end of the eighth grade.

what extent are other conditions the chief factors in the rate of progress?"

The Statistical Problem

The true relationships between the factors concerned are usually obscured by the errors in the measurements of these factors. The statistical analysis will attempt to determine the degree of these errors and make allowances for them. As chance inaccuracies in the data tend to produce lower coefficients of correlation the effect of making allowance for these errors of measurement is to increase the coefficients. Particular attention will be paid to the effort to determine the true correlation between the IQ and the Rate of Progress.

Checks Upon the Statistical Procedure

Statistics sometimes have an unhappy faculty of running away with the situation and leading to conclusions which are unreasonable. As a check upon the statistical analysis of the relation between the IQ and the Rate of Progress three methods were used. These are listed below:

1. A study of the teachers' reasons for failure.
2. An analysis of all cases which deviated significantly from the regression line.
3. A study of other factors to find what per cent of the cases of failure should be attributed to factors other than the IQ.

Factors Which Will Be Considered

This study will attempt to find the degree of relationship between the criterion, "Rate of Progress," and the following factors:

1. Intelligence[4]
2. Sex
3. Factors related to the home environment:

---

[4] Throughout this study the word "Intelligence" will be used to denote a degree of brightness. In most instances it has been determined by the Otis Classification Test.

a. The decease of one or both parents
b. Foreign parentage
c. Reading quotient (for 190 cases, 87 per cent foreign parentage)
d. Occupations of the fathers
e. Future plans of the pupils
f. Studying in a room by oneself
g. Number of other children in the family
h. Age of entrance to the first grade
i. Changes from school to school
j. Counselor's ratings of home conditions (63 cases)

4. Effort on the part of the pupils:
   a. Teachers' estimates
   b. The relation between the EQ and the IQ
5. Physical condition of the pupils:
   a. Absences
   b. Physical defects
   c. Physical Education records

II

Collection and Analysis of the Data

Preliminary Studies and Investigation of Previous Research

A series of preliminary studies were undertaken in order to find the best methods of collecting and analyzing the data. It was necessary to find the best forms of questionnaires; the most satisfactory tests to be used; the information which should be collected from pupils, teachers, and office records; the most economical methods of tabulating the data; the most illuminating methods of statistical analysis; and the most satisfactory system of classification for the teachers' estimates of the reasons for failure.

In connection with this preliminary work an attempt was made to analyze the studies which had been made on this subject since about 1910. Studies concerned with various aspects of this problem were reviewed and references filed in a cross index system.[1] It is not implied that all of the significant studies were located, but all which were discovered and could be obtained from libraries or universities were studied. It is likely that from these studies which could be located and analyzed a general idea of the situation with its possible implications was obtained. The studies which were most directly concerned with causes of failure or retardation group themselves into three classes. The first comprises those studies which deal with teachers' estimates of the reasons for failures.

The second group consists of analytical studies of one particular cause of failure. There is likely to be a tendency in this latter group for the investigator to attach more importance to the particular factor which he is studying than is attached to it by investigators who are studying some other factor. Consequently it is difficult to find out the truth about the whole situation by a combination of separate studies of individual factors.

The third group may be classified as philosophical studies.

[1] Frequent references to typical studies are made throughout the analysis.

These consist of discussions of the failure problem by men who have usually had a wide experience with the problem and they are doubtless frequently written from a background of analytical research. While conclusions from such studies cannot be interpreted in a quantitative sense, they are exceedingly valuable in that they point out possibilities which ought to be investigated.

When one tries to draw conclusions from some sort of a summary of these three types of studies he is faced with the task of trying to reconcile a series of divergent opinions and findings. The greatest divergence of opinion is in relation to the part played by the IQ as a factor in retardation. There is one group of studies based on teachers' judgments where very little emphasis is placed upon this factor, and another group where a much greater emphasis is placed upon it. The percentages given in Table 1 are as nearly the per cents found by the authors as could be calculated from the data presented.

TABLE 1

REPRESENTATIVE STUDIES OF THE CAUSES OF FAILURE

AUTHOR	PLACE	DATE	CASES	PER CENT OF FAILURE DUE TO LOW MENTALITY
McCormick[2]	Wisconsin	1922	950	5
Ayer[2]	Seattle	1925	3,715	22
	Maryland[2]	1925	25,509	15
	Philadelphia(1)[2]	1927	1,488	17
	Cleveland[2]	1918	6,250	43
Strayer[2]	Baltimore	1921	10,000[3]	43
Dickson (2)[2]	Oakland	1923	1,776	48

The above table is representative of some of the larger recent studies made in this field. It may be interesting to note two statements by Dickson, the author of the Oakland survey listed above. He expresses it as his opinion that three-quarters of the failures are due wholly or in part to children trying to do work beyond their ability.[4] In another book he says, "Mental tests

[2] These references are given in detail in the bibliography.
[3] Estimated from the data.
[4] V. E. Dickson (2): "Mental Tests and the Classroom Teacher," Chapter VIII.

given to nearly 30,000 children in Oakland prove conclusively that the proportion of failures due chiefly to mental inferiority is nearer 90 per cent than 50 per cent."[5] Investigators who have studied this factor of low mentality by itself are generally agreed that it is a very important cause of failure, if indeed not the most important cause.[6]

But other investigators find evidence of the fact that other factors are also at work.[7] There are also a long series of discussions usually not specifically based upon any one definite experiment which indicate that there may be a rather long list of factors which are to some extent responsible for failure or retardation.[8]

It is the purpose of the present study to take into consideration as many as possible of the likely factors and subject them to statistical treatment in an attempt to combine in one study an analysis of most of the probable causes of failure.

Collecting the Data

These data were collected from certain schools in the city of Philadelphia. They were gathered at the end of the fall term of the school year 1927–1928.

The Philadelphia schools are organized on the basis of half-yearly promotions. There are thus two "Terms" in each school year. The first term of a given grade is known as the "A" section, and the second term as the "B" section. Thus grade "1A" is the first half of the first grade, and grade "8B" is the last half of the eighth grade.

---

[5] V. E. Dickson (1): "Intelligence Tests and School Reorganization," Chapter II, page 33.

[6] See Banker, Cobb, Feingold (1–2), Flemming, Fuller, Gates, Poffenberger, Terman. See also VanDenburg for negative findings on other factors. See also Dearborn, and Freeman.

[7] See for Irregular Attendance: Gulick and Ayres, Gwinn, Keyes, Odell, Woodrow.

See for Overage at Entrance: Blan.

See for Size of Classes: Boyer, Elliot, Stevenson. (These investigators agree that the size of classes at least up to 45 or 50 has little to do with the progress of the pupils.)

See for Physical Defects: Ayres (2), Balch, and Twitmeyer.

See Beard for Dependency and Chauncey for Home Conditions.

[8] See Ayres (1), Courtis, Heck, and Woodrow.

Selecting the Grade

The pupils selected for this study were in the 8B grade in December, 1927. There were several reasons for this choice.

1. These pupils were about at the end of their period of general or unspecialized school work.
2. This grade enabled the study to include junior high schools, where information from the school counselors would be available.
3. Grades higher than 8B would eliminate the elementary schools from consideration, and grades below this would not be fair to the junior high schools, as the pupils would not have been in them a long enough time to show the results of the junior high school methods.
4. The Philadelphia Intelligence Test had been given to the elementary school pupils near the end of 8B, and to the junior high school pupils when they were in 6B. Scores from this test were thus available for both the elementary and the junior high school groups.

The Schools Studied

Three junior high schools and four elementary schools were chosen.[9] The selection of the schools was governed by the desire to obtain a representative cross-section of the schools in the city. The next few pages will be devoted to a study of these factors of representativeness.

Neighborhoods

The neighborhoods from which these seven schools drew their pupils included a wide range of social conditions. It is likely that the seven schools include some representatives of the most unfortunate neighborhood conditions and some of the best neighborhood conditions from which the public schools of Philadelphia draw their pupils.

Nativity of the Parents

About 46 per cent of the pupils were children of parents who had been born in non-English speaking countries. (Practically

[9] The names of these schools are on file in the Department of Elementary Education, University of Pennsylvania.

none of the pupils themselves were immigrants.) In 1928 the proportion of such foreign-born parents for the whole city was about 38 per cent.[10]

Percentages of Promotion

One junior high school was just about the average, one somewhat below, and one somewhat above the average in this respect. Two of the elementary schools were below the average in percentages of promotion and two were above the average.

Per Cents of Failures in 7th and 8th Grade Major Subjects[11]

To find, for descriptive purposes only, the normal number of failures per pupil to be expected from a given school, the following formula was used:

Normal failures [12] = .01784 (ΣPer cent of EQ's below 85, 90, 95, 100 − 74.2) + 2.43.

On this basis the number of failures per pupil is given in Table 2. The last column in this table indicates that the standards of marking were about the same for most of the cases in the study.

---

[10] See Philadelphia (3), Bureau of Compulsory Education.

[11] The term "failures" is used to designate the mean of the total number of failures per pupil in major subjects from grade 7A to grade 8B inclusive. The major subjects were English, History, Mathematics, and Geography or Science.

[12] This formula was derived as follows:

Let X = fEQ's
Y = Mean failures per pupil in a given school.
Y_N = Normal failures per pupil in a given school.
x = X − mean of the X distribution.
y = Y − mean of the Y distribution.

Then $y = \left(\frac{\Sigma xy}{\Sigma x^2}\right)x$ [13]

$Y = \left(\frac{\Sigma xy}{\Sigma x^2}\right)$ (fEQ's − Mean of the X distribution) + Mean of the Y distribution

Mean of X distribution = 74.2
Mean of Y distribution = 2.43
When fEQ's = ΣPer Cents of EQ below 85, 90, 95, 100,

$$\frac{\Sigma xy}{\Sigma x^2} = .01784$$

Therefore Y_N = .01784 (ΣPer Cents of EQ below 85, 90, 95, 100 − 74.2) + 2.43.

[13] See bottom of page 16.

TABLE 2
AVERAGE FAILURES PER PUPIL IN GRADES 7A TO 8B FOR THE SEVEN SCHOOLS IN THIS STUDY

SCHOOL	NORMAL	ACTUAL	RATIO OF ACTUAL TO NORMAL
A	1.91	2.05	1.07
B	1.99	2.65	1.33*
C	2.30	1.77	.77
D	2.47	3.07	1.24
E	2.61	2.88	1.10
F	3.08	1.51	.49*
G	5.05	5.95	1.18
Average		2.43	

* Note: These two schools include but 14 per cent of the cases studied.

The average pupil had attended three or more schools since entrance to grade 1A so that this difference in methods of marking was probably even less marked than would be indicated in Table 2.

Comparison of Mental and Educational Age Medians with National and State Norms

TABLE 3
MEDIANS FOUND IN THIS STUDY (1200 CASES) [14]

Otis mental age	14.65 years
Otis educational age	14.79 years
Chronological age	14.22 years

TABLE 4
MEDIANS FROM OTHER STUDIES

National norms (Otis)[15] for end of 8B	
Mental age	14.10 years
Educational age	14.50 years

[13] (From page 15)

$$y = r\left(\frac{\sigma y}{\sigma x}\right)x \quad \text{(see Rugg p. 251)}$$

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2}\sqrt{\Sigma y^2}} \quad \text{(see Rugg p. 274)}$$

$$\sigma y = \frac{\sqrt{\Sigma y^2}}{\sqrt{N}} \quad \text{(see Rugg p. 204)}$$

$$\text{and } \sigma x = \frac{\sqrt{\Sigma x^2}}{\sqrt{N}}$$

$$\text{therefore } y = \frac{\Sigma xy}{\Sigma x^2}x$$

[14] 961 of these cases were used in the basic correlation (see chapter III).
[15] Otis (1): "Otis Classification Test. Manual of Directions", p. 38.

State norms (Pennsylvania)[16] (18,376 cases)
Mental age.....13.30 years
Educational age.....14.80 years
Cities of Pennsylvania[17] (8,000 cases)
Mental age.....14.20 years
Educational age.....15.30 years

Distributions of MA, EA, CA, IQ, and EQ

Table 5 shows the significant facts in regard to the distribution of all of the cases for which the Otis test results were available. Not all of these cases could be used in any one of the comparisons made. The cases which had to be omitted from the basic correlation between IQ and Rate of Progress were scattered normally throughout the distribution, so that the 961 cases used in this correlation showed about the same distribution as that in Table 5. The means and standard deviations for the IQ's used in certain later analyses are given at various places in the text and may be compared with this table.

TABLE 5

DISTRIBUTIONS FOR ABOUT 1200 CASES

	MEAN.	MEDIAN	STANDARD DEVIATION	RANGE
MA.....	14.6	14.6	1.69	9.5 to 18.5[18]
EA.....	14.8	14.8	2.03	9.5 to 20.5
CA.....	14.6	14.2	.97	11.5 to 17.5
IQ.....	104.2	104.9	11.6	62 to 131
EQ.....	104.7	105.4	13.0	59 to 138

When a normal curve is superimposed upon the mental age distribution, the fit is very close for most of the range. At the upper end, however, the mental age curve is cut off rather abruptly. This is due to the fact that the test used was not adequate for the measurement of the highest mental ages encountered in the study. It is probable that the true mental

[16] From tables in Myers: "Measuring Educational Efficiency."
[17] *Ibid.*
[18] The highest possible score on Part II of the Otis Classification Test corresponds to a mental age of 18.75 years.

ages are distributed nearly symmetrically about the mean. The educational ages are skewed very slightly toward the lower end, while the chronological ages are skewed noticeably in this direction. The IQ's and the EQ's are skewed somewhat toward the upper end.

Data Obtained[19]

From Records

1. Date of birth
2. Date of entrance to grade 1A
3. Nativity of pupil, father, mother
4. Whether father or mother is deceased
5. Number of times pupil changed schools
6. 7A, 7B, 8A and 8B records
   a. Excused absences
   b. Unexcused absences
   c. Cooperation or effort marks
   d. Failures in each major subject
7. Medical records
8. (for some schools) Physical Education Department records, including:
   a. Weight
   b. Height
   c. Ability in track events
   d. Ability in apparatus work

From Tests

1. IQ from Philadelphia Intelligence Test.[20]
2. IQ and EQ, from the Otis Classification Test for Intermediate Grades, Form B.
3. For one school (about 200 cases) the Terman IQ.[20]
4. For one school (about 200 cases) the RA and RQ from the Thorndike McCall Paragraph Meaning Reading Scale, for four terms.[20]

From Teachers

1. Reasons for failure
2. Special notes about some pupils

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[19] These data were obtained for all of the pupils in grade 8B in the seven schools. In most of the analyses the whole group of pupils was considered, not simply the group of failing pupils.

[20] These tests were not administered under the direction of the investigator.

From School Counselors in the 3 Junior High Schools

1. Information about various pupils
2. From one school
   a. A rating of 46 pupils according to physical home conditions (subjective)
   b. A rating of 47 pupils according to total home influence (subjective)

From Pupils

1. Occupation of father
2. Chosen occupation
3. Future school plans
4. Number of other children in the family
5. Whether pupil studies in a room by himself

Validity and Reliability of the Otis Classification Test

In discussing the validity of his test in the Manual of Directions[21], Otis reports that for 286 cases in grades 4 to 8, the coefficient of correlation between Part I (Achievement) and a battery of six achievement tests[22] was .907. When corrected for attenuation this coefficient became .965. For 286 cases in grades 4 to 8 the coefficient of correlation between Part II (Mental Ability) and the National Intelligence Tests was .889, and between Part II and the Haggerty Intelligence Examination, Delta 2, it was .927. The coefficient of correlation between the National Intelligence Tests and the Haggerty test for these same cases was .925.

For 289 cases in grades 4 to 8 the reliability coefficients for Parts I and II were found to be respectively, .929 and .931. The probable error of an IQ or an EQ was about 3 points.

For the 1200 cases in this study the standard deviation for the mental ages was 1.69 years. By adding similar distributions for grades 4B to 8A inclusive, the standard deviation of the mental ages for grades 4 to 8 was found to be 2.34 years. Thus the reliability coefficient for Part I becomes .868[23] for a range of

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[21] Otis (1), Manual of Directions, pages 51–53.
[22] Otis (1), Manual of Directions, page 17.
[23] New coef. $= 1 - \left(\frac{\sigma \text{ old group}}{\sigma \text{ new group}}\right)^2 \left(1 - \text{old coef.}\right)$ Otis (2), page 237.

one half grade. As a check upon this figure the reliability coefficient was calculated from the alternate questions on 135 test papers. The papers were selected so that they gave a normal distribution of the scores on Part II. The coefficient of reliability was found to be .875.[24]

Scoring the Tests

Part II of 266 test papers (22 per cent of the total) was scored a second time and the IQ's were computed again. The average error was found to be 0.35 IQ points. The average error of the test itself (when compared with another form of the same test) was 3.5 points.[25]. Thus the arithmetical calculations of the IQ's were about ten times as accurate as the measurements of the IQ's by the Otis test. The IQ's which were found to be in error by this recalculation, were then replotted on the basic correlation chart for the determination of the relation of the IQ to the Rate of Progress. The original coefficient of correlation was .6659 and the corrected value was .6661. As the final coefficients of correlation found in this study are quite uncertain in the second decimal place, it would appear that the calculation of the IQ's was probably a hundred times as accurate as the results to be drawn from them.

Tabulating the Data

The data were tabulated on large cross-section sheets. A few of these data sheets were checked by reference to the original records. Very few errors were found.

The Effects of Errors in the Data

It is undoubtedly true there are some errors of scoring and tabulating running all through the data.[26] It is obviously im-

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[24] $r_{22} = \frac{2\, r_{11}}{1 + r_{11}}$ Otis (2), page 263.

[25] Average deviation = 1.18 probable error.
from Ave. Dev. = 1.18 Med. Dev., Otis (2), page 93.

[26] It is probable that many of the chronological ages are in error, and that a few of the dates of entrance to grade 1A are not correct. In the cases of disagreement about chronological age the age given by the pupil on his examination paper was used in preference to the age appearing on the office records.

possible to avoid all errors and the only way of counteracting these errors is by the calculation of reliability coefficients. While most of these errors will be taken care of by these reliability coefficients there will probably remain some uncorrected errors which will tend to give coefficients of correlation somewhat lower than we should have obtained had we had absolutely accurate data to work from. This fact should be remembered in the interpretation of all of the obtained coefficients of correlation. However, the effects of these errors of recording and tabulating the original data are very slight in comparison with the effects of the errors of such factors as the teachers' methods of promoting and the errors of the test results themselves.

The Analysis of the Data

It is the purpose of this study to attempt to find the true relationships existing between the rate of progress and certain factors which may be associated with it. As has been stated previously, these true relationships are obscured by the errors in the data. In order to penetrate this obscurity certain of the more important coefficients of correlation have been corrected for the attenuation due to the unreliability of the data. While such a correction is not permissible in a predictive study, it is impossible to approximate the statement of true *relationships* without its use. It is felt that it is less scientific to state half truths, even though they may be more reliable, than to approximate the truth as closely as possible with the data at hand.

That the correction for the unreliability of the IQ's is justified is indicated by footnote 9, page 26. It is beyond the bounds of reason to assume that no correction should be made for the unreliability of the criterion, rate of progress. The probable limits of this correction are discussed on pages 25, 31 and 54. However, the reader is at liberty to make whatever correction he desires for the unreliability of the criterion. The coefficient of correlation between rate of progress and IQ which he obtains by this procedure may be changed to a percentage value by means of Table 11 on page 39.

III

The Relation Between the Rate of Progress Through the Grades and the Intelligence Quotients of the Pupils

Introduction

It will be the task of Part I of this chapter to find the most likely value for a coefficient of correlation which will express the true relationship existing between the rates of progress through the grades and the intelligence quotients of the pupils, and then to change this coefficient into a percentage value which will express the extent to which intelligence, or some factor of which it is an expression, may be a causative[1] factor in relation to the rate of progress.

Part II of this chapter will examine the teachers' estimates of the reasons for failure in 545 cases of failure in major subjects in the 7th and 8th grades to see how well they agree with the conclusions drawn from Part I.

Part III will study all of the cases of moderately high IQ's which were noticeably retarded and all of the cases of moderately low IQ's which were accelerated to see whether this study of individual cases shows facts which might have been obscured in the statistical treatment of the group as a whole.

Part IV will discuss the chances of avoiding retardation with given IQ's.

Part V will summarize the findings of the chapter.

Part I—Rate of Progress and the IQ

Statistical Treatment

In order to find and interpret the relationship existing between

[1] In this and the succeeding chapter the factors will be considered in the light of their possible causative relationships. While the study presents no direct evidence of *causal* relationships, several of the relationships studied seem logical to be such, and for the sake of simplicity will be treated as such in these two chapters. In the final conclusions they will be stated as relationships only.

the IQ and the rate of progress of the pupils it will be necessary to find:

1. A reasonable criterion for the rate of progress
2. The reliability of the rate of progress criterion
3. The reliability of the IQ ratings
4. A reasonable method for translating coefficients of correlation into percentage values

The Rate of Progress Criterion

A rate of progress criterion[2] should be based on the actual rate of progress through the grades. It should also consider, to some extent at least, the chronological age at which the pupil attains the end of the grade in question, in this case grade 8B. This means that it is necessary to consider, as one of the factors in the criterion, the age of entrance to grade 1A.

Out of the 961 cases used in the final correlations 683 cases entered grade 1A at a normal age. This means they had reached their sixth birthday during the preceding term or they would reach it before the end of their first term in school. The remaining 278 cases were either under age or over age at entrance to grade 1A. A study of these cases revealed the following facts:

164 of these 278 cases were under age at entrance to grade 1A
- At the end of grade 8B, the theoretical median case was 1.113 terms retarded(i.e. required 16+1.113 terms to complete eight grades). (One term equals one half of a school year.)
- The median case had an IQ of 107.47

114 of the 278 cases were over age at entrance to grade1A
- At the end of grade 8B the theoretical median case was 0.278 terms accelerated (i.e. required 16−0.278 terms to complete eight grades)
- The median case had an IQ of 100.64

According to the final correlation chart (see page 29 where r = .666) the most likely rate of progress for an IQ of 107.47 was .64 terms in excess of the most likely rate of progress for an IQ

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[2] It should be recalled here that this study is regarding the rate of progress from the child's point of view. (See also footnote 1, page 7.)

of 100.64. Thus despite a probable handicap of .64 terms the overage pupils progressed 1.113+0.278 or 1.391 terms faster than the under age pupils. Thus the total difference between these two groups may be regarded as .64+1.391 or 2.031 terms. If the overage pupils had one half year subtracted from their rate of progress and the under age pupils had one half year added to their rate of progress this difference would be approximately neutralized.

Therefore, in applying the criterion to these 278 cases an allowance of six months was first made and then each additional year or fractional part of a year of variation of chronological age from the normal was balanced by one half year added to or subtracted from the rate of progress. The formula may be written in an approximate form as follows:

Rate of Progress[3] = 16 − Terms (Grade 1A to 8B inclusive) − ½ (Age at entrance − 6).

This means that an overageness at entrance of six months to a year and a half (or an average of about one year) is regarded as the equivalent of one term (one half year) of retardation.

In any criterion of progress the chronological age of a pupil should receive some consideration but it does not seem reasonable to give it the same value as an extra promotion or a non-promotion. By the above formula it is given one-half the value of an extra promotion or a non-promotion. It should be remembered that this correction was applied to but 29 per cent of the total cases. The correction was one term for 262 cases, two terms for 13 cases and three terms for 3 cases.

Of the 683 cases that entered at normal age there were about 15 cases where the date of entrance to 1A was not given. In these cases the pupil's rate of progress was determined by his chronological age at the end of 8B.

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[3] If rate of progress is positive, it is called "acceleration."
If rate of progress = 0, it is called "normal rate of progress."
If rate of progress is negative, it is called "retardation."

The Reliability of the Criterion

In order to find the reliability of promotions a group of 151 cases was chosen from one of the schools in the study. The cases in this group were about comparable with the total 961 cases in this study in regard to spread of IQ and spread of the criterion. They were not, however, the actual cases used in the other correlations in this study.[4]

The record cards were studied from 1A to 8B inclusive, and the algebraic sum of the non-promotions and extra promotions for each pupil for the last five years was correlated with the algebraic sum of the non-promotions and extra promotions for the preceding years. The number of preceding years averaged about four and one half. The coefficient of reliability was found to be $.51 \pm .04$.[5] There is some reason to believe that this value may be too low because the factors operating to cause failure might have changed during the years covered by these records.

In order to check up on this value, another class was studied. This group numbered 191 cases and was nearly like the total 961 cases.[6] This time the sum of the non-promotions and extra promotions for the fall terms was correlated with the sum of the non-promotions and extra promotions for the spring terms. The reliability coefficient as determined by the same formula was $.575 \pm .035$[5,7] for these cases. Changes in the factors influencing failure might operate to cause even this coefficient to appear slightly lower than it should. To allow for this effect a value of .60 was chosen as representing a reasonable figure.

From a study of these two values, a consideration of the accuracy of teachers' marks in general, and a careful study of the individual cases on the correlation chart it does not seem to be very likely that the true value for the reliability coefficient is much lower than .60 or much higher than .70.

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[4] These records were obtained later, and the records of the original cases were no longer available.

[5] These coefficients have been corrected for coarseness of grouping. $\sigma^2 = S^2 - 1/12$ (Sheppard's correction) Kelley, page 169.

[6] σ Prog. (191 cases) = 1.76, σ Prog, (961 cases) = 1.83

[7] This coefficient has been corrected for difference in range (See note 23, page 19).

The Reliability of the Determination of the Intelligence Quotients

For 918 out of the 961 cases the Otis test was used to obtain the IQ. For the remaining 43 cases the Otis equivalent of the Philadelphia IQ was used.

To find the true relationship between rate of progress and IQ it is necessary to know the reliability with which the IQ has been measured. To find this not only the reliability of the Otis test but also its validity for measuring IQ must be known. It is obviously impossible to find an exact numerical value for validity. However, by the use of certain approximations, one can employ the multiple correlation technique and find out the multiple correlation coefficient between rate of progress and IQ which would have been obtained if an infinite number of group intelligence tests similar to the Otis test had been used. The formula to be used is:[8]

$$r_{1(23\ldots N)} = r_{1x}\sqrt{\frac{N-1}{1+(N-2)\,r_{xx}}}$$

Where $r_{12} = r_{13} = r_{1N}$, etc. and $r_{23} = r_{24} = r_{2N}$, etc.

When $N = \infty$ this becomes:

$$r_{1(23\ldots\infty)} = r_{1x}\sqrt{\frac{1}{r_{xx}}}$$

It now becomes necessary to find a value for r_{xx}, the coefficient of correlation between one intelligence test and another. In the formula used it is understood that all intercorrelations between intelligence tests are equal. This is not exactly true in the present study and the assumption to be used here is that the use of an average value for these intercorrelations will not change the final result appreciably if the intercorrelations are approximately equal.[9] The value which will be used for the coefficient of intercorrelation will be taken as the average of three intercorrelations.

In one of the schools in this study the IQ's from the Otis, the Terman and the Philadelphia tests are available. This school represents the total situation quite fairly, as is evidenced by the

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[8] Holzinger, page 311.

[9] When three intelligence tests are used $N = 4$. Using the values $r_{1x} = .662$. (See page 28) and $r_{xx} = .825$ (see page 27), $r_{1(234)} = .705$. For these 167 cases (see page 27) the actual value of r between rate of progress and the average of the IQ's from the Otis, Terman and Philadelphia tests was .710.

comparisons in Table 6. (Sigmas and r's are corrected for coarseness of grouping.)[10]

TABLE 6

SIGMAS AND COEFFICIENTS OF CORRELATION FOR ONE REPRESENTATIVE SCHOOL

	TOTAL 961 CASES	ONE SCHOOL 167 CASES
Sigma progress	1.803 terms	1.768 terms
Sigma IQ	11.635 points	11.635 points
r Progress IQ—Otis	.680[11]	.634
r Progress IQ—Phila		.646
r Progress IQ—Terman		.690

From these 167 cases the following intercorrelation coefficients were obtained. (These coefficients have been corrected for coarseness of grouping.)

$r_{TO} = .797 \pm .019$
$r_{TP} = .826 \pm .017$
$r_{PO} = .853$[12] $\pm .015$

$\overline{r}_{II\ AVE.} = .825$

NOTE
T = Terman Test
O = Otis Test
P = Philadelphia Test
I = Intelligence Test

The sigma for the Otis IQ's was the same for both groups of pupils and it was assumed that the sigmas for the other tests would likewise have been practically identical for the two groups. This means that no correction need be made for difference in range as far as the intercorrelations between IQ's are concerned. It was therefore assumed that the value for r_{xx} was .825.

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[10] See note 5, page 25.

[11] Unless otherwise stated all coefficients are obtained by the Pearson product moment formula, $r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 + \Sigma y^2}}$ (Otis (2), page 189).

It was used in the form: $r = \frac{\Sigma x^2 + \Sigma y^2 - \Sigma v^2 - \frac{2\Sigma x \Sigma y}{N}}{2\sqrt{\left[\Sigma x^2 - \frac{(\Sigma x)^2}{N}\right]\left[\Sigma y^2 - \frac{(\Sigma y)^2}{N}\right]}}$ in which $v = x - y$.

[12] For 278 cases this was .842.

A correction needs to be made for the correlations between progress and IQ to give the values which we would expect from these 167 cases had the sigma of progress been the same as the sigma of progress for the total 961 cases.[13] The corrected values are as follows:

$$r_{\text{Prog. IQ Otis}} = .640$$
$$r_{\text{Prog. IQ Phila.}} = .651$$
$$r_{\text{Prog. IQ Terman}} = .695$$
$$r_{\text{Prog. IQ (Average)}} = .662$$

It will be noticed that the average of these coefficients is 3.44 per cent higher than the coefficient for the Otis test. This means that the other tests correlate slightly better with rate of progress than does the Otis test. Thus if the first basic coefficient for the 961 cases had been obtained from an average group intelligence test it would possibly have been 3.44 per cent higher than the obtained value (.680).

Summary of Corrections to be Made to Obtained Coefficient

1. *Attenuation due to unreliability of rate of progress ratings:*
Divide by the square root of .60[14]
2. *Multiple correlation with an infinite number of group intelligence tests:*
Divide by the square root of .825. (See page 26.)

Correlations between Rate of Progress and Intelligence Quotients

The group which was chosen for this basic correlation included all but 33 of the pupils who entered grade A1 and appeared on the 8B record sheets of this study and for whom an IQ rating was available. The Otis IQ was available for 918 cases and the Otis equivalent of the Philadelphia IQ was used for an additional 43 cases. The cases which were omitted included 33 immigrants from non-English speaking countries who entered 1A, 229 pupils who entered later than grade 1A and a number of other pupils for whom the IQ was lacking. Significant values are given in Table 7.

[13] See note 23, page 19.

[14] $r_{\frac{}{xy}} = \sqrt{\frac{r_{xy}}{r_{xx}r_{yy}}}$ Otis (2), page 229.

TABLE 7

SIGNIFICANT RELATIONSHIPS FOR THE BASIC CORRELATION BETWEEN RATE OF PROGRESS AND IQ

Number of Cases[15]	961
Raw coefficient of correlation[16]	.666 ± .012
Coefficient corrected for coarseness of grouping[17]	.680
Range of rate of progress	−9 terms to +4 terms
Range of IQ	69 to 130
Sigma progress (corrected for coarseness of grouping)	1.803 terms
Sigma IQ (corrected for coarseness of grouping)	11.635 IQ points
Mean rate of progress	16− .820 terms per 16 terms
Mean IQ	104.525
Median IQ	105.373

TABLE 8

DISTRIBUTION OF 961 CASES USED FOR THE BASIC CORRELATION

Otis IQ	RATE OF PROGRESS IN TERMS ABOVE OR BELOW NORMAL RATE														CASES
	−9	−8	−7	−6	−5	−4	−3	−2	−1	N	+1	+2	+3	+4	
130–134													1		1
125–129											3	7		1	11
120–124									3	20	36	17	2		78
115–119							2	3	15	38	55	16			129
110–114							3	18	27	49	36	8			141
105–109						5	6	16	42	48	25	4			146
100–104			1		1	5	13	31	43	29	10	1	1		135
95– 99				1	2	8	14	26	38	24	8	2			123
90– 94				2	5	10	18	23	25	14					97
85– 89			1	2	5	10	8	6	8	5	2				47
80– 84				2	3	7	4	3	9	2					30
75– 79	1	1		3	1	2	2	2	2						14
70– 74		1		2	2	1	2								8
65– 69			1												1
Cases	1	2	3	12	19	48	72	128	212	229	175	55	4	1	961

[15] The actual distribution of these 961 cases is shown in table 8.

[16] For other correlations of IQ and achievement, see Banker, Feingold (1), Flemming, Fuller, Gates, Poffenberger, Terman.

[17] As a check on this value of .680, η was found to be .671. (Corrected for coarseness of groupings this value becomes .678.) The formula used was

$$\eta = \frac{\sqrt{\frac{S[Nx(\bar{y}x-\bar{y})^2]}{N}}}{\sigma y}$$

Rugg, page 278.

The coefficient of correlation was also figured for the total 1,223 cases for which the IQ was available. This value was found to be .648. The corrected value was found to be .662. The fact that this correlation is lower than the one found for the 961 cases where the information was more complete is in line with the previously stated probability that inaccuracies in the original data act to reduce the obtained value of a coefficient of correlation. This conclusion was reached by a consideration of the fact that practically all chance errors tend to reduce the obtained value of a coefficient of correlation.[18] In the light of these considerations[19] it should be remembered that the obtained value for the 961 cases (.680) is probably lower than the actual value would have been had it been possible to eliminate all errors in the records and in the transcriptions of them. When one takes into consideration the two additional facts that the exact criterion for rate of progress has undoubtedly not been found and that even an infinite number of *group* intelligence tests would not measure intelligence perfectly, it will be seen that the obtained value, .680, is to be regarded as a *minimum* raw value for the expression of the relationship existing between rate of progress and IQ.

True Correlations Between Rate of Progress and Intelligence Quotients

Remembering, then, that these values are to be regarded as minimum values for the true relationship existing between rate of progress and intelligence quotients, the coefficients are as shown in Table 9.

Thus the probable limits are .894 and 1.00 with a most likely value of .966 as the expression of the true relationship between rate of progress and IQ.

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[18] e. g. In the correlation between rate of progress and IQ, chance errors tend to increase the partial sigmas of the rate of progress at each IQ level and thus reduce the coefficient of correlation.

[19] See also page 28, paragraph 2.

TABLE 9

COEFFICIENTS OF CORRELATION BETWEEN RATE OF PROGRESS AND IQ

Rate of Progress (actual) and IQ (actual)			.680
Rate of Progress (corrected for attenuation) and IQ (actual)			
Where $r_{PP}{}^{20}$ =	.56	.60	.70
$r_{\bar{P}I}{}^{20}$ =	.908	.878	.812
Rate of Progress (actual) and IQ (multiple)			.749[21]
Rate of Progress (corrected for attenuation) and IQ (multiple)			
Where r_{PP} =	.56	.60	.70
$\bar{P}(I_1I_2 \ldots I\infty)$ =	1.00	.966	.894

The Method of Changing a Correlation to a Percentage Value

The first step in finding the percentage relationship is to plot the regression line passing through the means of the progress scores at each IQ level. This line is shown on Figure 1, page 33, as a solid line. The tangent or slope line[22] is drawn in as a dotted line and this curved regression line is made to coincide with the slope line as nearly as possible without going too far from the actual means of the progress distributions (which are shown as small circles)[23]. It will be noticed that the slope of a tangent to this curved line becomes less at the top and at the bottom of the curved line. This may be explained by the supposition that failure begets failure and that success inspires success. But whatever the explanation may be the means lie so nearly along a

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[20] P = rate of progress.
I = IQ.

[21] If a 3 per cent correction (see page 28) is made, this value becomes .771. Considering other disturbing factors such as errors in the recorded chronological ages the true value is probably about .8.

[22] $b_1 = r\frac{\sigma y}{\sigma x}$ (b_1 = tangent of regression line.) Rugg, page 262.

[23] On another similar chart the tangent was drawn for a coefficient of 1.000 with the distributions on both scales the same as before. The means were again calculated from such a distribution of the cases that a perfect rank relationship existed between rate of progress and the IQ while the two distributions remained as for the original coefficient of .666. A smooth curve was drawn by the method described for the coefficient of .666. Similar charts were drawn for coefficients of .75, .85, .94, and .98. In these latter charts the smooth curve was drawn tangent to the proper slope line but following the general directions of the smooth curves for the coefficients of .666 and 1.000. Percentage values for additional coefficients of correlation were obtained by interpolation.

smooth curve that it may be assumed that such a curved regression line actually exists.

The next step is to find the partial sigmas of the rate of progress. These partial sigmas represent the sigmas at each intelligence level. The formula is $\sigma_{P.I} = \sigma_P \sqrt{1-r^2_{PI}}$.[24] For the basic correlation (.666) for the 961 cases, $\sigma_P = 1.803$, and $\sigma_{P.I} = 1.345$. This value of 1.345 represents the average standard deviation from the mean for each IQ interval. It was found, however, that the standard deviation was much greater at the lower end of the IQ scale, so that it would not be proper to use this value throughout the whole IQ range.

There is one evident reason for this difference. There is a greater chance for variability where the number of non-promotions is greater and the non-promotions themselves are probably not so accurately determined as the normal progresses or the extra promotions. As the corrected correlations become greater, due partly to the greater assumed accuracy of the progress ratings, this difference will become less. There is, however, the probability that there is actually a closer relationship existing between extra promotions and IQ than there is between non-promotions and IQ. Whatever difference is caused by this latter factor would not decrease with higher correlations. The most reasonable assumption to make therefore, seems to be that the difference would decrease but not disappear entirely with high correlations.

The actual median deviation for each IQ level was plotted on a chart. A line was then drawn through these points in such a way that it followed the general trend of the points without going as low as the small differences at the high end of the IQ scale nor as high as the greater differences at the low end of the IQ scale. The curve thus fitted most perfectly the cases where the coefficients of correlation were somewhat higher than .666. (It should be noted here that the final percentages are not very greatly affected by changes in these theoretical median deviations.)

From these theoretical values a set of partial sigmas were calculated for each IQ interval for six different coefficients of correla-

[24] Kelley, page 173.

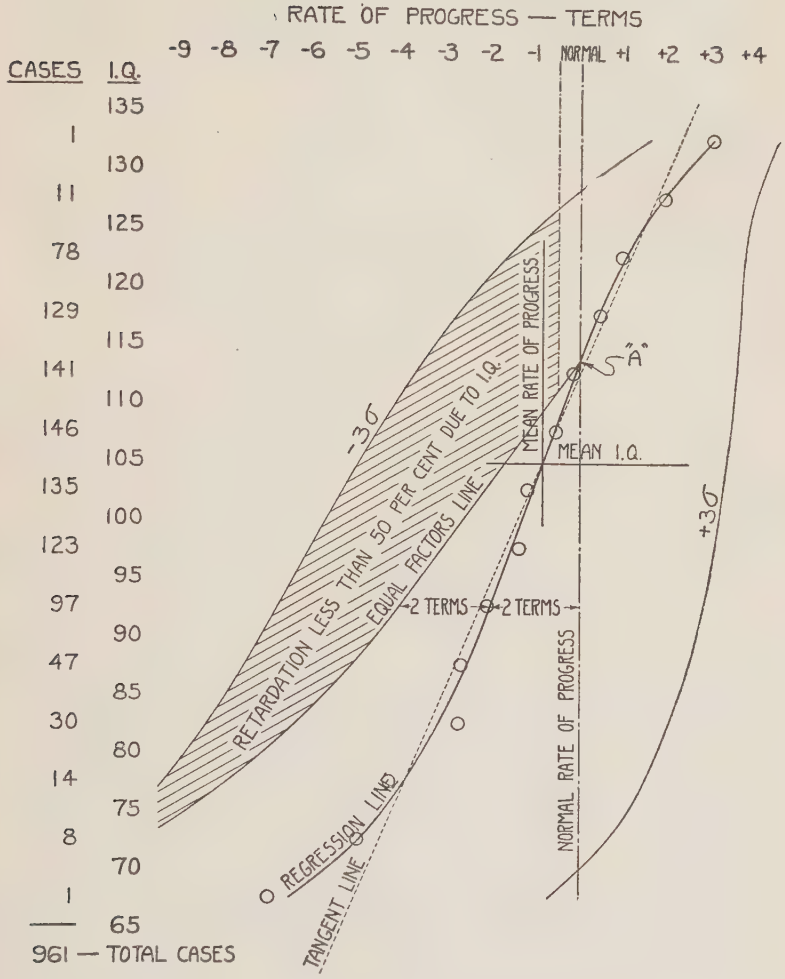

FIGURE 1

CHART ILLUSTRATING THE METHOD OF CHANGING A CORRELATION TO A PERCENTAGE VALUE (r_{IP}=.666)

tion in such a way that for each correlation the sigmas bore a constant relation to these theoretical median deviations at each IQ interval and in such a way that the average partial sigma was equal to the partial sigma which could be calculated from the given coefficient of correlation.

Table 10 shows these partial sigmas for certain values of the coefficients of correlation.

TABLE 10

PARTIAL SIGMAS OF RATE OF PROGRESS FOR VARIOUS IQ INTERVALS, WHERE THE COEFFICIENTS OF CORRELATION ARE: .666, .75, .85, .94, .98 AND 1.00

IQ	COEFFICIENTS						CASES
	.666	.75	.85	.94	.98	1.00	
130–134	.485	.430	.343	.222	.130	0	1
125–129	.704	.623	.497	.321	.188	0	11
120–124	.898	.795	.634	.410	.240	0	78
115–119	1.068	.945	.753	.488	.285	0	129
110–114	1.213	1.074	.857	.553	.324	0	141
105–109	1.335	1.182	.943	.610	.357	0	146
100–104	1.445	1.279	1.020	.660	.386	0	135
95– 99	1.530	1.354	1.079	.699	.408	0	123
90– 94	1.603	1.419	1.130	.731	.428	0	97
85– 89	1.675	1.483	1.182	.765	.447	0	47
80– 84	1.736	1.537	1.224	.792	.463	0	30
75– 79	1.808	1.600	1.279	.825	.483	0	14
70– 74	1.870	1.655	1.320	.853	.500	0	8
65– 69	1.941	1.719	1.370	.886	.518	0	1
Average	1.345	1.191	.950	.615	.359	.000	
Total							961

The method of calculating the per cents will be described for one coefficient. (The same method was used for all of the other coefficients and it is not necessary to describe it for each of them.) By referring to Figure 1, page 33, it may be seen that a distance of three partial sigmas has been laid off on each side of the regression line for each IQ interval. Lines have been drawn through these points. Thus an area has been marked off which includes three partial sigmas on each side of the regression line. This area will include all but 0.27 per cent of the cases if the cases fall

into a normal distribution.[25] These lines were also drawn in on the actual correlation chart for the coefficient of .666 and it was found that the area thus enclosed included all but three cases. In other words it included all but about 0.3 per cent of the total cases. This happens to agree almost exactly with the value given above. It is thus safe to assume that this area will include about 99.7 per cent of all the cases and that the error involved by ignoring the area beyond this is negligible. (In the Rugg tables to be used later on, even this 0.27 per cent is included in the curve between minus three sigma and plus three sigma so that the final error is insignificant.)

The next line to be drawn on the chart in Figure 1 is marked the "Equal Factors Line". This line has been drawn from the point on the regression line where it crosses the center of the normal progress distribution. (This point has been marked "A" on the chart.)[26] From this point "A" the Equal Factors Line has been drawn down to the left of the regression line in such a way that it is always as far to the left of the regression line as the regression line is to the left of the center of the normal progress distribution.

This line has been drawn in this position on the assumption that

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[25] Rugg, page 390, Table III (continued).

[26] It is assumed that above this point (A) the IQ's tend to cause acceleration and below it they tend to cause retardation. On the chart where the coefficient of correlation has a value of .92 this point represents an IQ of 111 on the Otis scale. This is equivalent to an IQ of 107 on the Philadelphia test and an IQ of 104 on the Terman test according to the comparison of the 167 cases where the three tests were available (see page 27). For high coefficients of correlation it may be assumed that the IQ is the chief factor at work as a cause of failure. So one may feel fairly confident that for high correlations it is safe to take the point "A" at the intersection of the regression line and the center of the normal progress block.

For lower coefficients this policy becomes less and less valid so that for coefficients below about .40 or .50 it gives quite erroneous conclusions. For the coefficient given on Chart 1, namely, .666, this assumption undoubtedly gives a somewhat erroneous conclusion.

For relatively low coefficients of correlations the most reasonable assumption seems to be to take the point "A" as the mean of the total distribution of the factor under consideration. This means that if a given factor exerts an influence on rate of progress it may be assumed that the presence of less than the mean amount of this factor exerts an influence in one direction and the presence of more than the mean amount of this factor exerts an influence in the other direction. This is simply the assumption which is least likely to be in error to a serious extent and if it is used with very low coefficients it is probably as accurate as some of the other conditions of the situation.

the displacement from normal progress which is produced by a factor or a series of factors tending to cause retardation is directly proportional to the strength of that factor or series of factors, or conversely, *the influence which is exerted by a factor or a series of factors is directly proportional to the displacement from normal progress which is produced by the factor or series of factors.* This means that if pupil "P" was absolutely normal in every respect but "home conditions" and if his home conditions were such that they caused a retardation of two terms, while pupil "Q" was identically like pupil "P" with the exception that his home conditions had twice the power to cause retardation that the home conditions of pupil "P" possessed, then pupil "Q" would be retarded four terms.

Throughout the whole physical world there exists the very general law that the change produced is directly proportional to the force producing the change, provided one deals with changes which are not too great. Reasoning by analogy one might expect to find here the same type of relationship governing displacements which are not too extreme and differences in factors which are not too great. In the situation under consideration it will be seen from a glance at Figure 1, that most of the cases are not too greatly displaced nor are most of the forces too greatly different in strength.

In the situation under consideration there is also the additional fact that this law does hold with a high degree of accuracy for one of the factors, namely intelligence. For the range covered by about 99 per cent of the cases the regression line is practically a straight line. This means that for a range covering 99 per cent of the cases the average displacement is directly proportional to the IQ. It would seem to be unlikely that any other factor or series of factors would follow any other law which was so different that it would throw out, to any serious extent, figures based on this assumption.

Referring again to Figure 1 it is seen that a pupil with an IQ of 92.5 is likely to have a retardation of two terms due to his position on the regression line. If he has a retardation greater than two terms it may be assumed that (in the case of the average pupil) factors other than the IQ are at work tending to cause

retardation. If he has two more terms of retardation, or a total of four terms, he is on the "Equal Factors Line" which means that factors other than IQ are as much responsible for his retardation as is his IQ. If he has a total of five or more terms of retardation he is in the cross-sectioned area marked "Retardation Less Than 50 Per Cent Due to IQ." To find the total number of cases of retardation more due to other causes than to IQ it is simply necessary to find the number of cases in this area. It was assumed that all cases in each IQ row were bunched along the center of the IQ row and the number of cases was then computed from a knowledge of the per cents of cases lying between minus three sigma and the right-hand boundary of the cross-sectioned area at the center of each IQ row.[27]

For this particular chart (where the coefficient of correlation equalled .666) the percentage of retardation more due to other causes than to the IQ was found to be 38.6. (Therefore retardation due to IQ = 61.4 per cent.) When the actual cases instead of the three sigma distributions were plotted on the chart the percentage was found to be 30.4. (Retardation due to IQ = 69.6 per cent.) This difference is probably caused by the fact that the actual IQ distributions above an IQ of 90 are skewed to the right thus throwing fewer actual cases in the retardation area than one would normally expect to find there. This skewness is so general that it may be accepted as a true picture of the actual situation. A correction (called the "Skewness correction") might have been made in the coefficients in the summary of this chapter to take care of this difference. Such a correction would have increased the per cents of retardation due to IQ.

If the most likely value for the true coefficient of correlation is taken as .966 it is found that aside from inaccuracies in marking and promoting pupils (on whatever basis they are promoted) that about 93 per cent of the cases of retardation are more than half due to the IQ of the pupils. For the pupils who are two or more terms retarded the percentage is about 99 and for pupils who are three or more terms retarded the percentage is about 100.

It should also be realized in this connection that the majority

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[27] Rugg, pages 396–400, Table VI.

of the pupils whose retardation is attributed more to other factors than to IQ would have had some retardation due to their position on the regression line even if the other factors to which their retardation is now attributed had been absent.

By using the estimated value (.8 as in note 21, page 31) for the coefficient of correlation which expresses the relationship between true IQ, as measured by an infinite number of group intelligence tests, and the actual rate of progress of the pupils it is found that about 72 per cent of the cases of retardation are due to the IQ. Allowing 8 per cent for other factors leaves about 20 per cent due to chance variations in marking and promoting pupils. This percentage should be regarded as an incident accompanying the process of retardation rather than as a true cause of retardation. In this and succeeding chapters this 20 per cent has been statistically eliminated by the use of a reliability coefficient for the rate of progress. This procedure has the effect of distributing this 20 per cent among the factors which may be presumed to act as true causes of retardation.

The probable limits as previously estimated (page 31) for the coefficients of correlation would fix the percentage for all cases of retardation due to the IQ between 82 and 100, and the percentage of cases of three or more terms of retardation between 91 and 100.

In Tables 11 and 12 are given the percentage equivalents for certain coefficients of correlation. These have been calculated by the method just described. They may be used to determine percentage values for other coefficients of correlation in case it is desired to see what the relationships would have been if other values had been chosen for the reliability of the rate of progress criterion or the IQ. It should be remembered that these values are based on the series of assumptions previously discussed, and are applicable only to this particular relationship of IQ to rate of progress for this particular distribution of cases.

Finding the Percentage Value for a Factor by the Normal Curve Probability Method

This method will be used here as a check upon the method previously described. It will also be used later in the study for

analyzing relationships which are too slight to give results by the former method. As it is based upon a series of assumptions for whose validity there is only indirect proof its validity is not very reliable for evaluating relationships of high degree, but it is useful as a rough check. For slight relationships, however, it is the only method which the writer can discover.

TABLE 11

PER CENT OF THE TOTAL CASES OF RETARDATION DUE PRIMARILY TO THE IQ

COEFFICIENT OF CORRELATION	PER CENT
1.00	100
.95	90
.90	83
.85	77
.80	72
.75	68
.70	64
.65	60

TABLE 12

PER CENT OF THE CASES OF THREE OR MORE TERMS OF RETARDATION DUE PRIMARILY TO THE IQ

COEFFICIENT OF CORRELATION	PER CENT
1.00	100
.95	99
.90	92
.85	85
.80	78
.75	70

It uses the assumption previously developed (page 35) that the influence of a given factor is directly proportional to the mean displacement caused by this factor. A percentage value is obtained by dividing this displacement by the mean retardation of the group under consideration. It is then assumed that for the average case the retardation is to this extent caused by this factor. But it also assumes that in some of the cases this factor

exerts more than this percentage of influence and in some of the cases less than this percentage of influence. It assumes that this influence varies in accordance with the normal probability curve[28] so that at the minus three sigma end of the population scale it exerts no influence and at the plus three sigma end of the scale it exerts 100 per cent of all the influence tending to cause retardation.

Consider the case where a given factor is 10 per cent responsible for the retardation of the average case. This situation may be represented as in Figure 2.

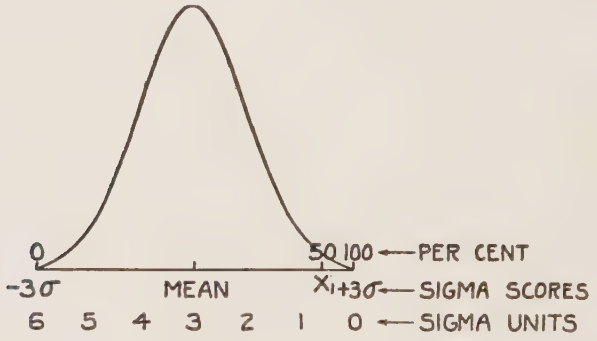

FIGURE 2

NORMAL CURVE PROBABILITY METHOD

It is desired to find the location of the point (x_1) on the sigma scale where the factor is 50 per cent responsible for the retardation. In all cases to the right of this point it may then be assumed that the factor is more than half responsible for the retardation. The method of locating this point (x_1) can best be illustrated by reference to the following diagrams. Figure 3 shows the situation described above, and Figure 4 is added to show the situation where the factor under consideration is assumed to be 60 per cent responsible for the retardation of the average case.

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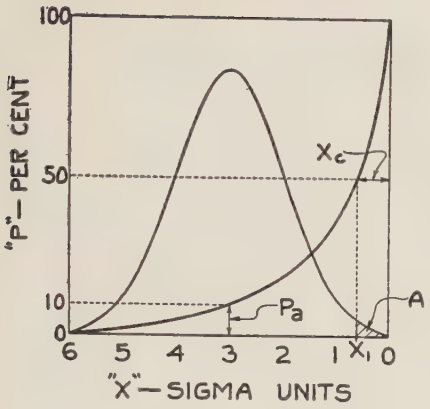
[28] The normal probability curve fits a great majority of the physical and mental traits met in educational research. It is used here as the most likely distribution of the per cents.



$$x_c = \frac{6}{100} \text{ Pa}$$

Pa = 10

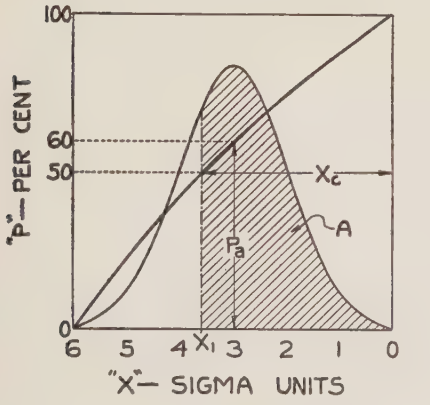
x_c = 0.60

A = 0.68 per cent of total cases under normal curve[29]

FIGURE 3

NORMAL CURVE PROBABILITY METHOD

(Where the given factor exerts an influence on the average case which is 10 per cent of the total influence.)



$$x_c = \frac{6}{100} \text{ Pa}$$

Pa = 60

x_c = 3.60

A = 72.61 per cent of total cases under normal curve[29]

FIGURE 4

NORMAL PROBABILITY CURVE METHOD

(Where the given factor exerts an influence on the average case which is 60 per cent of the total influence).

[29] See Rugg, pages 396–400, Table VI.

It is obvious that the location of the point "x" depends upon the shape of the heavy curve running from the point x = 6, P = O to the point x = O, P = 100. The curve chosen was a hyperbolic curve symmetrical about the line running through the points x = 6, P = 100 and x = O, P = O. This curve will give a value of x_c (the critical "x" value) which is the same proportion of 6 that P_a (the percentage influence on the average case) is of 100. A curve of this type gives a certain value of x_c when P_a equals "k", and the same value for 6 minus x_c when 100 minus P_a equals "k." For example, when P_a equals 60, x_c equals 3.60 and A equals 72.61 per cent, and when P_a equals 40 (or 100 minus 60) x_c equals 2.40 (or 6 minus 3.60) and A equals 27.39 per cent (or 100 per cent minus 72.61 per cent). This seems to be the situation which should logically be expected.

In using percentages based upon the shape of this curve, one should realize certain facts:

1. When P_a is in the neighborhood of 50, the shape of the curve is relatively unimportant.

2. When we are getting an average value from a series of applications of this method, in which the cases are normally distributed, and in which the values of P_a are evenly distributed above and below the 50 per cent value the shapes of the curves are relatively unimportant. (This is the situation which will be approximated in the use of this method in the present chapter.)

3. When the values of P_a are between 10 and 30 (or between 70 and 90) changes in the shape of the curve will produce significant changes in the results.

4. When the values of P_a are below 10 the results are decidedly dependent on the shape of the curve, but they will still be very low so long as the curve has any reasonable shape.

As this method will be used in a number of later discussions, Table 13 showing its applications to various conditions will be given here.

This method was applied to the cases of retardation shown on Table 8, page 29. A separate calculation was made for each one of the blocks in the retardation area. The value of P_a was obtained by dividing the retardation at the center of the block by the mean progress of all the cases at that IQ level. By this

method it is found that the IQ is responsible for 64.6 per cent of the cases of retardation. It will be recalled that by the first method, described on pages 31 to 38, a value of 69.6 per cent was obtained from the actual distribution of the cases and 61.4 per cent from a theoretical distribution of the cases. Thus it is seen that these two methods, each based upon a series of reasonable assumptions, give results which are nearly alike.

TABLE 13

PER CENT VALUES BY THE NORMAL CURVE PROBABILITY METHOD

PERCENTAGE INFLUENCE OF THE GIVEN FACTOR ON THE AVERAGE CASE	PER CENT OF THE TOTAL CASES INFLUENCED 50 PER CENT OR MORE BY THE GIVEN FACTOR
0	0
10	1
20	4
30	11
40	28
50	50
60	72
70	89
80	96
90	99
100	100

PART II—TEACHERS' REASONS FOR FAILURE

In order to have some method of checking up on whatever the statistical analysis might reveal the teachers in all of the schools in the study were asked to give their opinions as to the chief cause of the failure of each pupil who had had three or more failures in major subjects from the beginning of grade 7A to the end of 8B. From the original group of about 1200 cases there are 476 cases[30] for which these teacher ratings are available. In addition to these there are 69 other cases from one of the schools in the study. These latter cases were taken from the 8B class of the succeeding term and are similar to the other cases in the study. It was felt that their inclusion would reduce the errors due

[30] These cases comprise practically all the pupils in the study who had three or more failures in major subjects.

to sampling to a greater extent than it would introduce errors of non-comparability. The comparisons made in this chapter will be drawn from the data obtained from a study of the total 545 cases, although a secondary analysis showed that the results would have been practically the same if only the original 476 cases had been used.

TABLE 14

REASONS FOR FAILURE

The students listed below have, at some time from 7A to 8B, failed in the subject named on this sheet.

	Poor mental ability	Lack of effort due to desire to leave school	Lack of effort due to other reasons	Poor Health	Behavior problem	Unsatisfactory home conditions	SPECIAL NOTES Details, in the cases of poor physical vitality or unsatisfactory home conditions, are especially helpful.

DIRECTIONS—Put (1) for the primary cause. Put (2) if there are one or more secondary causes.

You will note that there is no heading for "Irregular attendance." If failure is due to this cause put the check numbers under the headings causing the irregular attendance.

If you do not have any information which would enable you to make a reasonable estimate of the cause of failure this fact may simply be noted opposite the student's name.

The most valuable part of this study will come from any special notes you may be able to make on the right-hand side of this sheet.

Each home room teacher was supplied with a copy of the data sheet shown in Table 14, page 44. In the left-hand column were written in the names of all his pupils who had had three or more failures in *any* major subject or combination of subjects from 7A to 8B inclusive. It follows that many home room teachers were asked to rate pupils who had not failed in the subjects which they taught. The data sheets presented to the other teachers contained only the names of those pupils who had failed in the subject taught by that particular teacher, although the failure in that subject might have occurred with some other teacher in a preceding term.

The six headings on this data sheet were chosen after considerable study of other data sheets and after experimentation with two other sets of headings. The headings were made as self-explanatory and as mutually exclusive as possible. It did not seem advisable to attempt to analyze each of the headings. Discussion with many of the teachers who used these sheets brought out the fact that they felt reasonably sure of the assignment of most of the cases. On the final data sheets, the teachers were specifically asked not to check cases where they could not make a reasonable estimate of the cause of failure. The principals were also asked to explain to their teachers that the investigator was trying to get reliable information and that it would be better to make no entry at all beside the pupil's name than to try to figure out a reason without a sufficient basis upon which to form a judgment. When the data sheets were collected it was found that most of the names had been checked on each sheet.

It was felt that a detailed analysis of each heading would simply cause confusion and would not, in the long run, add anything to the accuracy of the judgments. In general there was a marked consensus of opinion in regard to individual cases. Of the 272 cases assigned[31] to "Low Mentality" 124 cases had two or more checks for this cause and no checks for any of the other causes. In 34 additional cases there were at least two more checks for this cause than for all others combined. The 272

[31] See page 46 for the method of assigning these cases to the several categories.

cases had an average of 2.46 checks for this cause and an average of 0.51 checks for all the other causes combined.

Reactions from principals and teachers have indicated that a great deal of care was taken in the checking of these sheets. The average pupil received a "Reason for Failure" check from three teachers. In addition to this a great many cases were rated by the school counselors. The data from the individual teacher sheets were transferred to section master sheets and the reasons for failure were summarized for each pupil. The pupils were then grouped by causes of failure according to the majority of teacher and counselor opinions. Most of the teachers made a first choice only. When second choices occurred they were counted as having half the influence of a first choice. There were about 45 cases which were tied between two causes. These were left until the end and then distributed between the two headings in proportion to the numbers of cases already in these two headings.[32] In a few cases where the failures had occurred in a previous term and, because of the number of absences, it seemed obvious that the cause was "poor health", the teachers' judgments were disregarded.

On the final record sheets the following information was tabulated:

Average number of excused absences per term.[33]
Average number of unexcused absences per term.
Average "Effort" or "Cooperation" mark.[34]
Total number of failures.[35]
IQ (Otis)
EQ (Otis)
Total of votes for each reason for failure.
Notes by teachers and counselors.
Medical records.

The distribution of the 545 cases is summarized in Table 15.

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[32] There were 38 cases which were tied between "Poor mental ability" and "Lack of effort." The cases with the lowest IQ's were assigned to "Poor mental ability."

[33] For the cases assigned to "Poor health" this information was listed separately by terms.

[34] *Ibid.* [35] *Ibid.*

TABLE 15
TEACHERS' ESTIMATES OF CAUSES OF FAILURE

CAUSE	CASES	PER CENT
Low mentality	272	49.9
Lack of effort[36]	166	30.5
Poor home conditions[37]	46	8.5
Poor health	45	8.2
Behavior problems	16	2.9
	545	100.0

A first glance at this table would give one the idea that the teachers' estimates of reasons for failure were very seriously in opposition to the thesis that 90 per cent or more of the serious failure was caused by low mental ability.[38] It will be recalled from page 29 that the raw correlation between IQ and rate of progress yielded a coefficient of .680. Based on this figure the per cent of the cases caused by the IQ was about 62. The higher value (about 93 per cent) was obtained by making allowances for the errors of promoting and testing. In the case of the teachers' judgments these errors have not been corrected. Thus if the teachers had said that about 62 per cent of the failure was due to low mental ability there would have been a very close correspondence between the two methods. But there is an added reason why the teachers' judgments, if accurate, must of necessity be less than this value of 62 per cent.[39] In the statistical analysis the rate of progress since grade 1A was taken as the criterion, while in the case of the teachers' judgments the numbers of failures in grades 7A to 8B inclusive was taken as the criterion. Table 16 shows the relationship between IQ and failure.

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[36] Includes "Lack of effort due to desire to leave school" and "Lack of effort due to other causes."

[37] Includes 26 cases where the majority of teacher opinion would have indicated some other category, but where the counselor's notes showed serious home difficulties.

[38] This term is used in a relative sense. It will be recalled that on page 35 it was found that an IQ on the Otis scale below 111 seems to be conducive to failure.

[39] For other studies of teachers' reasons for failures, see Ayer, Cleveland, Dickson (2), Elwood-et.al., Gaylor, Maryland, McCormick, Nifenecker, Percival, W. P., Philadelphia (1-2), Salt Lake City, Strayer, Turney, Williams, Yeager.

For pupils' reasons see Gardner, Grizzell, Jackson.

TABLE 16

CORRELATIONS BETWEEN IQ AND FAILURE

Average IQ and severity of failure[40]	−.53 (1177 cases)
Otis IQ and number of failures	−.41 (1102 cases)
Rate of progress and number of failures	−.49 (191 cases)

The coefficient of correlation of .680 (between IQ and rate of progress) corresponded to a per cent of about 62. While there seems to be no good method of changing so low a coefficient as .4 or .5 into a per cent, it seems likely that it would correspond to a per cent much lower than 62. The per cent which was obtained from the teachers' judgments, namely 49.9 would seem to be at least as high as would have been obtained by statistical methods if corrections for our imperfect knowledge of the true IQ's of the pupils had not been made and if the less accurate criterion of "failure" has been used instead of the "rate of progress".

The most valuable part of the analysis of the teacher judgment data, however, is the study of individual cases to see whether it is possible to transfer enough of them to the "Low mentality" category[41] to correspond to the per cents which were determined by statistical analysis. Each of these headings will be considered separately.

Under the heading "Lack of effort" are found 166 cases. Of these, all but 36 cases had IQ's below 111, or below the point at which the IQ seemed to exert a retarding influence. On the rate of progress basis only two cases with IQ's above 111 had been retarded more than one term and several of them had been accelerated. When one takes into account the fact that the obtained IQ's are inaccurate and that even the rate of progress basis is inaccurate it is seen that there is reason for believing that most if not all of these cases might be transferred to the "Low

[40] See Table 31, page 73.

[41] It is not likely that many "Low Mentality" cases should be transferred to other categories. Only 4 cases had IQ's above 110 (see page 35 for discussion of 111 as a critical value) while 75 per cent of the cases had IQ's below 100 where the chances of escaping retardation are less than 1 in 4 (see page 53, table 19).

mentality" category without doing violence to any of the known facts.

Under the heading "Poor home conditions" there is found a normal distribution of IQ's. However, only one case with an IQ above 111 (and it was 112) had more than one term of retardation. When a counselor sees that the home conditions of certain pupils are very poor there is a natural tendency to attribute the failure of such of these pupils as do fail to this condition. It will be seen however, in Chapter IV, page 71, that by one of these counselor's own ratings the relationship between failure and home conditions became slightly negative when the influence of the IQ was partialled out. There is thus no definite evidence here that all of these cases or at least all of those involving noticeable retardation may not be transferred to the "Low mentality" category.

The next category is "Poor health" with 45 cases. About 20 of these cases have IQ's low enough and absences low enough that the failures may easily be attributable to "Low mentality". The failure of the remainder, or about 4.5 per cent of the 545 cases seems to be pretty certainly due primarily to poor health. It is difficult to tell what this percentage would have been if the study had been made on the rate of progress basis and if the health records from grade 1A up had been available.

The last category, "Behavior problems" contains 16 cases. None of these has an IQ above 110.

In summarizing this part of the chapter it is found that the teachers' estimates of reasons for failure agree closely with the statistical analysis up to the point where corrections for the unreliability of the data are made. An analysis of the individual cases shows that it is perfectly possible that all but about 4 or 5 per cent due to poor health may be transferred to the "Low mentality" column when cases of retardation of more than one term are considered. When one considers all cases of retardation it is likely that a small additional per cent of the cases cannot properly be shifted to the "Low mentality" category. That such transfers are possible indicates that the teachers' judgments are not necessarily in opposition to the previous statistical finding that about 93 per cent of the retardation may be attributed to the IQ's of the pupils.

Part III—Analysis of Cases Which Deviate from the Regression Line

Thus far the analysis of cases has been in terms of probabilities. The question naturally arises, "Are some individual pupils with moderately high IQ's noticeably retarded, and are some with moderately low IQ's accelerated?" That is, it may be true that while the mathematical chances say that the answer to this question is, with very few exceptions, in the negative, a study of individual cases may reveal many instances where pupils with moderately low IQ's do progress rapidly and where pupils with moderately high IQ's do progress slowly.

The mere fact that there are inaccuracies in the formulation and application of the rate of progress criterion and in the obtained IQ's of the pupils makes it self-evident that some variation will be found from the regression line. But if the variation is very wide for a reasonably large group of pupils, this situation cannot be accounted for by these incidental errors.

The sigma value for the rate of progress distribution is equal to 1.8 terms. A variation of two terms from the median of this distribution is thus equal to a little more than one sigma and thus is a moderate variation, in comparison with the total semi-range value of more than three sigmas. If the value of −1 (or one term retardation) is taken as an expression of the central tendency of the rate of progress distribution, it will be profitable to study the cases showing acceleration of one or more terms and cases showing retardation of three or more terms.

TABLE 17

Accelerated[42] Pupils With IQ's Below 100

Cases	Acceleration (terms)	IQ		Per cent having failures in 7th and 8th grades
		Mean	Range	
2	2	97.5	97–98	50
10	1	94.7	87–99	50
Total successful pupils				
235	1–4		87–130	24.8

[42] Acceleration of one or more terms, by definition of "rate of progress" on page 24.

The mean value for the IQ's was found to be 104.5. Sigma was found to be 11.6. IQ's below 100 and IQ's above 109 will be studied. These IQ's thus vary less than one half sigma from the mean.

It will be seen from Table 17 that 12 pupils with moderately low IQ's were accelerated. But it will be noticed that they had more than their share of failures in 7th and 8th grades. (One pupil had 5 failures and another pupil had 7 failures in major subjects.) A further analysis of these cases reveals the fact that six out of the twelve cases have chronological ages approximately 6 months in excess of the normal for their rate of progress group. It is also found that for seven cases where the Otis equivalent of the Philadelphia IQ is available the Philadelphia test gives an IQ which averages 3.3 points higher than the Otis IQ.

On the Otis test basis there is an EQ excess of 5.8 points over the IQ. On the Philadelphia test basis this excess would be about 2.5 points.

There are only two cases where the IQ is below 95 on the Otis basis. One IQ is 87 and the other is 88. In neither case are both test results available to use as checks. Neither of these cases has any 7th or 8th grade major subject failures, or is overage for its rate of progress classification. Each is one term accelerated.

TABLE 18

NOTICEABLY RETARDED[43] PUPILS WITH IQ'S ABOVE 109

CASES	RETARDATION[44] (TERMS)		IQ	
			MEAN	RANGE
5	3		112.8	110–116
TOTAL FAILURE PUPILS				
157	3–9			69–116

[43] Retardation of three or more terms, by definition of "rate of progress" on page 24.

[44] The median rate of progress is −.82 terms.

It may, therefore, be said that on the basis of one test alone there appear to be 2 pupils out of about 220 with IQ's below 96, who are accelerated to an appreciable extent beyond the central tendency of the whole group. The degree of acceleration is not marked, nor are the IQ's much more than one sigma below the mean (an IQ of 92.9 is one sigma below the mean).

It will be seen from Table 18 that 5 pupils with IQ's above 109 by the Otis test are retarded to an appreciable extent beyond the central tendency of the rate of progress distribution. For 3 cases where the Otis equivalent of the Philadelphia test is available the Philadelphia test gives IQ's which average 2 points above the Otis values. The average IQ excess is about 2 points.

Further analysis shows that 3 out of the 5 cases are approximately 6 months or more underage for their rate of progress classification. The two remaining cases will be discussed somewhat in detail. One case has an IQ of 113 by the Philadelphia test alone. This pupil had no failures in major subjects in either the 7th or the 8th grades. The "Cooperation" marks average G—. It is entirely possible that this retardation was due to previous Poor Health, or to a wrong classification, as the date of entrance does not appear on the records. The remaining case has an Otis IQ of 116, and an Otis equivalent of the Philadelphia IQ of 119. His EQ is 117. He is retarded 3 terms and has a record of 7 failures in major subjects in the 7th and 8th grades. His average "Effort" mark is "F—". He has an average absence record for grades 7 and 8 of 14 days per term. This is excessive but not in itself sufficient to account for the failure. Most of the absence appears to be due to illness and it is possible that the cumulative effect of possible illness throughout his school life has resulted in decreased effort on his part.

In summarizing this section, one certain case was found (out of 360 cases with IQ's above 110) where the pupil is retarded to an appreciable extent beyond the central tendency. This IQ (116) is almost exactly one sigma above the mean. In this case it is possible that the retardation was caused by poor health.

Part IV—Chances of Avoiding Retardation With Given IQ's

The table which follows shows the relationship between IQ and retardation in still another way. It points out rather strikingly the influence which the IQ seems to exert on the rate of progress. The per cents as given in the column headed "Actual" are calculated from the actual distribution of cases shown on page 29. The per cents in the column headed "Theoretical" are calculated from the distribution which would be obtained by using the partial sigmas on page 34, which correspond to a coefficient of correlation of .749, the value given on page 31 for the expression of the relationship between the rate of progress and the IQ as it would have been obtained from an infinite number of group intelligence tests. It therefore represents the actual chances of avoiding retardation with any given true value of the IQ.

TABLE 19

Chances of Avoiding Retardation by the End of 8B
(chances are expressed as per cents)

IQ	Cases	Actual Chances (IQ by one group intelligence test)	Theoretical Chances[45] (IQ by an infinite number of group intelligence tests)
130–134	1	100	100
125–129	11	100	100
120–124	78	96	97
115–119	129	86	85
110–114	141	66	62
105–109	146	53	47
100–104	135	30	30
95– 99	123	28	23
90– 94	97	14	13
85– 89	47	15	7
80– 84	30	7	7
75– 79	14	0	1
70– 74	8	0	0
65– 69	1	0	0
	961		

[45] This column is based upon the assumption that there are an infinite number of cases at each IQ level, grouped about the means shown in Figure 1

Table 19 is based on nearly one thousand cases and may therefore be taken as approximately true.[46] It indicates that no matter what other factors are at work, the pupil with an IQ of 120 or above is practically certain to avoid retardation by the end of 8B if he remains in school. If he loses time through illness and thus loses a term of school he apparently makes this time up before the end of 8B. It also indicates that for the pupil with an IQ below 90 the chances of avoiding retardation are negligible. The chances of avoiding retardation with IQ's between 90 and 100 are very slight.

If it is assumed that the IQ does not change very much in eight or nine years[47] it seems to be a reasonable conclusion that we could determine the IQ of each pupil at entrance to grade 1A and from this information determine with a high degree of accuracy certain cases which would be practically certain to avoid retardation and certain other cases which would be practically certain to be retarded by the time they reached the end of grade 8B.

Part V—Summary

In this chapter it has been seen that there is apparently a high degree of relationship between the IQ and the rate of progress. It was seen on page 31 that the coefficient of correlation between the actual rate of progress and the true IQ (as measurable by group intelligence tests) was probably about .80. It can hardly be assumed that the reliability coefficient for the rate of progress can be greater than .80. This places the minimum value for the coefficient of correlation between the true IQ (as defined above) and the theoretical rate of progress (as defined by the practice followed for these 961 cases) at about .89. All other factors combined could not, therefore, be related to the rate of progress (unless they were themselves related to the IQ) in a closer relationship than would be expressed by a coefficient of multiple

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[46] While there are few cases at the extremes, it will be seen from Figure 1, page 33, that the means of these cases lie along an even curve.

[47] See Lincoln.

correlation of .46.[48] This indicates that the IQ is at least twice as important as all other factors combined in the case of the average retarded pupil.

Of the total factors associated with retardation the IQ seemed to be the factor most closely related to the rate of progress in about 93[49] per cent of the total cases of retardation, in about 99 per cent of the cases of more than normal retardation, and in about 100 per cent of the cases of three or more terms of retardation.

The analyses of the teachers' reasons for failure and the cases which do not follow the regression line closely do not present evidence that the above conclusions are not sound. As will be seen in the next chapter, an analysis of a number of other factors does not yield any definite indication that this relationship is not as close as has been found in the present chapter.

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[48] To obtain a multiple correlation of 1.00 between rate of progress and all factors (including the IQ) one of the partial correlations must become 1.00. The formula for the partial correlation coefficient is:

$$r_{12.3} = \frac{r_{12} - r_{13}\, r_{23}}{\sqrt{(1-r_{13}^2)\,(1-r_{23}^2)}}$$ Otis (2), page 232.

In this present situation $r_{23} = 0$, where "2" = IQ, and "3" = all other factors.

[49] The probable lower limit of this value is 82 per cent. (See page 38.)

IV

The Relation Between the Rate of Progress Through the Grades and Factors Other Than the IQ

Introduction

In the preceding chapter it has been seen that an analysis of the relationship between the IQ and the rate of progress has led to the probability that the IQ is responsible for about 93 per cent of the total cases of retardation. If it is found, by a study of other factors, that any combination of some of these other factors is apparently responsible for more than about 7 per cent of the total cases of retardation, it will be necessary to revise this estimate or at least examine it again to find the cause for the discrepancy.

When the data were originally collected it was recognized that any one of a long series of factors might act to cause retardation, and so a great many facts were recorded on the original data sheets. It is not at all likely that all of the most important factors have been recorded, but some idea of the influence of such factors may be implied from the relationships existing between the rate of progress and those factors which have been recorded.[1]

It will be remembered that a list of factors to be studied was

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[1] A fairly large number of the most likely factors will be studied. It will be seen that only one of these factors shows a relationship with rate of progress which may be expressed by a coefficient of correlation as high as .3. To investigate the possibility of these and other, undiscovered factors combining to influence the rate of progress, the following hypothetical cases will be presented:

Case 1. Where $r_{pf_1} = .3$, $r_{pf_2} = .3 \ldots\ldots r_{pf_5} = .3$
and $r_{f_1f_2} = .0, r_{f_1f_3} = .0, r_{f_2f_3} = .0$ etc.
$r_{p(f_1f_2f_3f_4f_5)} = .6$

Case 2. Where $r_{pf_1} = .3 \ldots\ldots r_{pf_{10}} = .3$
and $r_{f_1f_2} = .1, r_{f_1f_3} = 1, r_{f_2f_3} = .1$ etc.
$r_{p(f_1f_2 \ldots\ldots f_{10})} = .67$

Case 3. Where $r_{pf_1} = .3 \ldots\ldots r_{pf_\infty} = .3$
$r_{f_1f_2} = .2, r_{f_1f_3} = .2, r_{f_2f_3} = .2$ etc.
$r_{p(f_1f_2 \ldots\ldots f_\infty)} = .67$

From the above cases it will be seen that the multiple correlation resulting from any of these hypothetical combinations is less than the correlation existing between rate of progress and IQ. It is exceedingly unlikely that any such combination of factors is at work in an appreciable number of cases.

given on page 9. These factors will be studied in the order in which they were listed on that page. The main headings were: Sex, Home Environment, Effort on the Part of the Pupils, and the Physical Condition of the Pupils.

Sex Differences

The sex factor presents difficulties in ten-fold complexity. It was found that the girls made an average of 0.454 terms greater progress than the boys when similar IQ distributions were compared. The boys, however, made an actual average rate of progress which was 0.338 terms greater than the actual average rate of progress for the girls. The explanation of this apparent discrepancy lies in the consideration of the fact that the median IQ of the boys is 107.45 while the median IQ of the girls is only 103.57. The coefficient of correlation between sex and rate of progress with IQ held constant is $.26 \pm .02$.[2] There are at least three possible explanations for the apparent IQ superiority of the boys. One possibility is that boys are brighter than girls. As far as the writer knows there is no definite data supporting this conclusion.[3] The second explanation is that the group intelligence test used may be easier for boys than for girls. The writer does not advance this as a probability but simply as a possibility which helps to complicate matters.[4] The third explanation is the fact that it is probably easier for boys of low IQ to drop out of school and go to work than it is for girls of low IQ. In the first

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[2] Bi-serial correlation.

$$r = \frac{(\text{Mean}_2 - \text{Mean}_1)\,pq}{\sigma z} \quad \text{(see Kelley p. 248)}$$

$$\sigma r = \frac{\left(\frac{\sqrt{pq}}{z} - r^2\right)}{\sqrt{N}} \quad \text{(see Kelley p. 249)}$$

$$PE_r = .6745\sigma r$$

In order to hold the IQ constant the average difference between the means for each IQ level was used in the formula instead of "$\text{Mean}_2 - \text{Mean}_1$." This gives approximately the result which would have been obtained had the coefficients been calculated separately for each IQ interval and then averaged.

[3] See Cameron, Dearborn, Freeman, Minnick.

[4] See Dearborn and Freeman for opinions representing the probability of an approximately equal IQ distribution for boys and girls.

eight grades of the Philadelphia schools, the numbers of each sex are about equal.[5] A study of the number of pupils on roll in grade 8B in the schools in this analysis shows that there were 599 boys and 681 girls. This lends support to the theory that the boys drop out of school at a faster rate than the girls. That it is the boys with low IQ's who drop out is indicated by the facts from Table 20.

TABLE 20

RELATION OF IQ TO SEX

Total cases in the basic correlation	961
Boys	436
Girls	525
Cases with IQ's below 110[6]	
Boys	245
Girls	356
Cases with IQ's of 110 or more	
Boys	191
Girls	169

From the last two figures, however, it is seen that despite the greater elimination of the boys, one finds more boys than girls with high IQ's. This shows that the elimination explanation can be only partially responsible for the apparent IQ superiority of the boys.

If this IQ superiority of the boys is entirely fictitious, the boys progress 0.338 terms faster than the girls, while if this IQ superiority is just what it appears to be, the girls progress 0.454 terms faster than the boys of the same IQ's. There is definite data tending to show that the boys of low IQ do drop out of school at a faster rate than the girls of low IQ, so that it is reasonable to assume that there is actually some IQ superiority of the boys who remain in school. Thus it is likely that the fact that the boys progress at a rate 0.338 terms faster than the girls is not a true

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[5] See Philadelphia (4), Report for the Year Ending June 30, 1928. Pupils on roll in first eight grades in elementary schools. Boys, 93,147; Girls, 93,074. (January 1928, Table No. 16); and Boys, 88,908; Girls, 88,981. (June 1928, Table No. 35.)

[6] It will be recalled that in Chapter III an IQ of about 111 was regarded as the critical value.

representation of the situation when the differences in the IQ's are taken into account. On the other hand, while it is more likely to be nearer the truth, it cannot be definitely proved that the finding of the 0.454 terms greater rate of progress for the girls of equal IQ's tells the whole story.

If, for the sake of argument, the latter figure is taken at its face value and one assumes that the fact of being a girl is an aid in progress and the fact of being a boy is a hindrance to the extent of a mean difference of 0.454 terms, it is found by the normal curve probability method (see page 38) that the fact of being a boy may be responsible for the retardation in about 0.5 per cent of the total cases of retardation.

The most reasonable assumption seems to be that there is evidence that the fact that a pupil is a boy is the chief factor in retardation in a very small per cent of the total cases of retardation.

Factors Related to the Home Environment

The Decease of One or Both Parents

The first factor studied was the decease of one or both parents. Out of the 961 cases there were definite records of 74 cases in which one or both parents were deceased. These 74 cases constitute 7.70 per cent of the total of 961 cases. For the 464 cases of no retardation the percentage was 8.4, while for the 497 cases of retarded pupils the percentage was 7.04. The median IQ of these 74 cases is practically identical with the median IQ of the 961 cases. For the same IQ distribution these 74 cases made a mean rate of progress 0.138 terms faster than the whole group of 961 cases.

Apparently the decease of one or both parents does not act to cause retardation. (The actual coefficient of correlation between decease of one or both parents and rate of progress with IQ held constant was $.06 \pm .04$).[7]

Foreign Parentage

One finds, in various studies, the conclusion that the factor of

[7] Bi-serial correlation (see page 57).

foreign parentage is to some extent a factor in retardation.[8] Out of the 961 cases in the basic correlation of this study, there are 442 cases where both parents[9] were born in non-English speaking countries. For these pupils the average rate of progress for each IQ group is 0.248 terms faster than the average rate of progress of the whole group. This means that the pupils who had both parents born in non-English speaking countries had an average rate of progress 0.459 terms faster than the pupils who had one or both parents born in the United States, Canada, England, Scotland or Ireland. (It might be noted that nearly all of these other 519 cases had both parents born in the United States.) The median IQ's of the two groups were practically identical. (Median IQ foreign parentage group = 105.125, median IQ whole group = 105.373.) The coefficient of correlation (biserial "r") between nativity of parents and rate of progress (the IQ is constant) is .26 ± .02. (The foreign parentage group made the greater progress.)

It would not do to draw from these figures the conclusion that foreign parentage is a factor in the rate of progress. There are too many other factors of race,[10] inheritance, testing difficulties, etc. bound up in these distributions to enable one to draw any very definite conclusions. But it is reasonable, in view of the 0.459 terms of superiority of the foreign parentage group, to believe that foreign parentage is not a very potent factor in retardation. There seem to be, however, some factors which are

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[8] Philadelphia (2) ,1928.

[9] Only those cases whose parents were both born in non-English speaking countries were chosen for this comparison. It was thought that the factor which has at various times been credited with being a cause of retardation was the factor of language difficulties. It is not likely that if one of the parents was born in the United States there would be very serious language difficulties in the home.

[10] The question of the influence of "race" on the rate of progress is sometimes raised. While this factor may have some influence on the rate of progress it is not possible to study it by itself in an analytical study of this kind. In the first place there is no one accepted list of races to use as a basis and in the second place the races have become so mixed in the United States that any study of them would have to take into account the percentage of the various races in the blood of each pupil. This is not only beyond the range of our present methods of gathering data, but will probably always remain so due to the fact that the characteristics of the different races do not appear in the same proportions in different children of the same parents.

connected with the parentage of the pupils, and which are not reflected in the IQ's as measured by the intelligence test used, which do have some effect upon the rate of progress of the pupils.

Reading Quotient

As a further check upon the question of language difficulties the Reading Quotients were obtained for the pupils in one of the schools which contained a large proportion of children of foreign parentage. In this school 87 per cent of the pupils had parents both of whom had been born in non-English speaking countries. It was thought that for this group of pupils the reading quotients might show a certain relation to the rate of progress which was not reflected by the IQ. This comparison can be made with a considerable degree of accuracy as the average of three or four reading quotients (from the Thorndike McCall Reading Scale) and the average of the IQ's from three different group tests of mental ability[11] are available for this school. Some of the most important coefficients of correlation are given for 190 cases in Table 21.

TABLE 21

The Relation of the Reading Quotient to the IQ and the Rate of Progress

IQ and Reading Quotient	.885 ± .010
IQ and Reading Quotient (Corrected for Attenuation)	.981
Reading Quotient and Rate of Progress	.687 ± .026
Reading Quotient and Rate of Progress (Corrected for Attenuation)	.949
IQ and Rate of Progress (for this group)	.657 ± .028
IQ and Rate of Progress (Corrected for Attenuation)	.933
Reading Quotient and Rate of Progress with IQ held constant	.25 (Not reliable. See text below.)

This table indicates that the reading ability of a pupil is a factor in his rate of progress independently of his IQ. Too much significance cannot be placed, however, in this partial correlation because a change of 3 per cent in any of the above coefficients of correlation would have made the partial correlation negative instead of positive. The most significant coefficient of correlation

[11] Otis, Terman, Philadelphia.

among those above is the one expressing the relationship between the Reading Quotient and the IQ. This value is .981, which indicates that whatever differences in reading ability there are in the schools is measured with a very high degree of accuracy by the IQ (provided, of course, that the IQ is measured accurately).[12]

It may be concluded from these two studies of foreign parentage and reading ability that the influence of having parents who were born in non-English speaking countries is not a significant cause of retardation except in as much as it may be reflected through the IQ.

Occupations of the Fathers

Counts, in his monograph on the Selective Character of American Secondary Education, finds that the two occupational groups which, according to their sizes, are represented in high schools by the greatest number of pupils are the managerial and the professional groups. The two groups which are represented by the smallest proportion of pupils are the personal service and the common laborer groups. It was thought possible that there might be some relationship existing between the rate of progress and the group to which the father of the pupil belonged. The above extreme groups were chosen for the comparison. Certain facts about these two groups in relation to the rate of progress are given in Table 22.

TABLE 22

Relation of Occupations of Fathers to the IQ and the Rate of Progress

Median IQ of the whole group (961 cases)	105.373
Median IQ of managerial and professional group (102 cases)	110.75
Median IQ of personal service and laborer group (63 cases)	98.54
Coefficients of correlation (Bi-serial, see page 57) between rate of progress and occupation of fathers, when the IQ's are kept constant:	
Managerial and professional groups	$-.02 \pm .05$
Personal service and laborer groups	$.10 \pm .06$

[12] The converse is of course true. Thus whatever conclusions are drawn relative to the IQ, hold practically as well for the Reading Quotient. The terms might possibly be used interchangeably.

It will be seen from the above table that the relation between the rate of progress and the occuptions of the fathers, even for these extreme groups, is so slight in comparison with the probable errors of the coefficients of correlation that one is only justified in saying that there may be a slight tendency for the pupils whose fathers belong to the laboring and personal service groups to do a little better in school in comparison with their IQ expectancy than the pupils whose fathers belong to the managerial and professional groups.

Future Plans of the Pupils

By the responses to the pupils' questionnaires it was found that the plans of the pupils after leaving the school they were now attending were as shown in Table 23.

TABLE 23

FUTURE PLANS OF THE PUPILS

	CASES
Going to college	282
Going to normal school	98
Going to business college	35
Going to work	81
Going to high school only	465[13]
Total	961

The 35 cases of pupils planning to go to business college show an approximately normal distribution of IQ's, rate of progress, and mean rate of progress deviation from the regression line running through the means of the progress distributions for each IQ group of the total 961 cases. Due to the small number of cases in this group and their normal distribution these cases will not be considered further.

Significant facts about the other cases in relation to the total distribution of the 961 cases are given in Table 24.

[13] A few cases where the response was doubtful were included in this group.

TABLE 24

FUTURE PLANS OF THE PUPILS, RATE OF PROGRESS AND IQ MEANS

Mean rate of progress for the 961 cases	− .820 terms[14]
Mean rate of progress for the college group	− .322 terms[15]
Mean rate of progress for the normal school group	+ .060 terms[16]
Mean rate of progress for the work group	−2.235 terms[17]
Mean IQ for the 961 cases	104.525
Mean IQ for the college group	108.875
Mean IQ for the normal school group	109.300
Mean IQ for the work group	97.800

A study of this table will show that the group which is planning to go to work is greatly retarded in comparison with the total 961 cases. However it will also be noticed that the mean IQ of this group is also much less than the mean IQ of the total group. To find how much of this retardation is due to the IQ the average difference between the means of the progress distributions for each IQ group for each of these classes of pupils and the means of the progress distributions for each IQ group for the total 961 cases was determined.

These differences are shown in Table 25.

TABLE 25

RELATION BETWEEN FUTURE PLANS OF THE PUPILS AND THE RATE OF PROGRESS

	Average difference between progress means for each IQ group for the several classes of pupils and the progress means for each IQ group for the total 961 cases
College group	.05 ± .06 terms above total means
Normal school group	.14 ± .10 terms above total means
Work group	−.68 ± .11 terms above total means

This table shows that the groups planning to go to college and normal school have progress means above those to be expected from their IQ's while the group planning to go to work has a progress mean below that to be expected from the IQ's of the pupils in this group. The differences in the means for the college

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[14] This rate of progress is expressed in terms of deviation from the normal (16 terms in 8 years).

[15] *Ibid.* [16] *Ibid.* [17] *Ibid.*

and normal school groups are so small that when translated into per cents they are insignificant.

When one comes to study the effect of planning to go to work upon the rate of progress he must take into consideration the possibility that this group of pupils is planning to go to work because it has not been successful in school rather than that it has not been successful in school because it is planning to go to work. Thus it is not at all likely that this difference between means should be translated in per cents of casual relationship.

In order to guard against any possibility that such a casual relationship exists it will be assumed, for a moment, that the obtained difference between means is the true difference and that the relationship is entirely one in which the desire to go to work is a factor tending to cause retardation. Of the group planning to go to work a total of 69 cases were retarded for an average of 2.67 terms. The group as a whole is retarded 0.683 terms beyond the retardation to be expected from their IQ's. This is 25.6 per cent of the average retardation of those pupils in this group who are retarded. If it is assumed as on two or three other occasions that this is equivalent to saying that for the average case this factor is 25.6 per cent of the total strength of the factors acting to cause retardation and the normal curve probability method (page 38) is applied, it will be found that this factor is the major cause of retardation in about 7 per cent of the 69 cases. This means that it is the major cause of retardation in about 4.8 cases. These 4.8 cases constitute less than 1 per cent of the total of 497 retarded pupils.

The coefficients of correlation as found by the bi-serial method are given in Table 26.

TABLE 26

PARTIAL COEFFICIENTS OF CORRELATION BETWEEN FUTURE PLANS OF PUPILS AND RATE OF PROGRESS

	COEFFICIENT
College	.04 ± .03
Normal School	.08 ± .04
High School only	.07 ± .03
Work	−.37 ± .04

Studying in a Room by Oneself

Another factor which might be expected to throw some light on home conditions is the question of whether or not the pupil studies in a room by himself. This factor was measured by the responses of the pupils to a short questionnaire on the intelligence test booklets. The results are available for 888 of the 961 cases. The means for the two groups are shown in Table 27.

TABLE 27

THE RELATION BETWEEN STUDYING IN A ROOM BY ONESELF AND THE RATE OF PROGRESS

	"DO YOU STUDY IN A ROOM BY YOURSELF?"	
	"YES"	"NO"
Rate of Progress	0.415[18]	0.227[19]
IQ	2.415[20]	3.600[21]
Number of cases	553	335

The coefficients of correlation by the bi-serial "r" method are given in Table 28.

TABLE 28

COEFFICIENT OF CORRELATION BETWEEN STUDYING IN A ROOM BY ONESELF AND RATE OF PROGRESS

	RAW COEFFICIENT
Study and progress	.0645
Study and IQ	−.063

The probable error is about .029.

Another method was used to find an approximate value for the coefficient of correlation between Study and Progress. The difference between the mean IQ's of the two groups was 1.185. If this is translated into probable differences in progress by the regression line where the coefficient of correlation between IQ and the rate of progress is .666 it is found that it represents a prob-

[18] Means are in terms of deviation from given IQ and Rate of Progress values.
[19] *Ibid.* [20] *Ibid.* [21] *Ibid.*

able difference of 0.126 terms of progress. This means that the cases that studied in rooms by themselves had a mean IQ which was such that a rate of progress 0.126 terms less than the rate of progress of the other group would normally have been expected of them. Adding this to the obtained difference in progress (0.188 terms) there is a difference of 0.314 terms between two groups whose IQ's are the same. Substituting this value in the formula for bi-serial "r" (see page 57) a value of .106 is obtained for the coefficient of correlation between Study and Progress when the groups studying by themselves and not studying by themselves have the same mean IQ. Corrected for the attenuation of the IQ and the rate of progress rating this becomes .15. It is not safe, however, to regard this entirely as an expression of casual relationship, because it is very possible that the rates of progress of the different pupils may be the cause of the negative correlation between IQ and study habits and hence of a large part of the obtained coefficient of correlation between Study and Progress.

It was found that the factor of studying in a room by oneself may be responsible for an average difference in the rate of progress of 0.314 terms. The displacement toward retardation (or the displacement toward acceleration) may be taken as half of this value, or .157 terms. This is 7.2 per cent of the mean retardation (2.19 terms) of the total cases of retardation. Applying the "normal curve probability" method, it is found that 0.4[22] per cent of the cases of retardation affected by this factor may be regarded as being more closely related to this factor than to any other factors. On the basis of the 888 returns it may be assumed that 183 cases of retardation (out of the total of 497) did not study in rooms by themselves. 0.4 per cent of these 183 cases is 0.73 cases. This is 0.15 per cent of the total cases of retardation. It is obvious that such a slight percentage is negligible.

Number of Other Children in the Family

Another factor which might throw some light on the relation of home conditions to failure is the number of other children,

[22] When separate calculations are made for each rate of progress interval the result is practically the same.

under eighteen years of age, in the family of the pupil under consideration. This relationship was found for an approximately normal group of 175 cases.[23] The coefficient of correlation was found to be .056 and the coefficient of correlation between IQ and the number of other children in the family was found to be —.084. Here the partial correlation with the influence of IQ taken out is an insignificantly small positive value, which means that there is a very slight tendency for the children in larger families to have a higher rate of progress. This coefficient as actually obtained is .06 with a probable error in the neighborhood of .05. It is so small that it is meaningless.

Age at Entrance to Grade 1A

From a study of age-grade tables it is frequently inferred that late entrance is an important cause of retardation in those cases where the pupils enter grade 1A at a chronological age greater than the normal. The retardation inferred from a study of age-grade tables is, of course, based on the chronological age. It will be recalled here that the word "retardation" as used in this study refers to a situation which is determined largely by the actual rate of progress from the time of entrance to grade 1A, corrected somewhat for the age at entrance. Thus the discussion of "late entrance" as a cause of failure has little meaning for this particular study. It will be discussed, nevertheless, for the sake of the proper orientation of this study in relation to other studies based on other definitions of retardation.

It will also be recalled that on page 24 we said that pupils who entered grade 1A at a chronological age greater than about 6.5 years had a median rate of progress in reference to their IQ expectation of 2.031 terms (1.015 years) more than that of the pupils who entered grade 1A at a chronological age of less than about 5.5 years. The average difference in chronological ages between these two groups was not very greatly in excess of one year, so that it may be seen that while the older children were retarded (on a chronological age basis) at entrance the average

[23] Choosing 175 cases in one representative school kept many other factors constant. The size of the resultant partial correlation (+.0) was not large enough to warrant further analysis.

over-age pupil made up most of this difference, while the average under-age pupil lost most of the advantage of the fact that he entered at a low chronological age.[24]

Changes from School to School

The fact that some pupils are shifted around from pillar to post and that some of them make as many as 12 changes in schools has been regarded by some investigators as an important factor in causing failure.[25] Whatever the importance of this factor may be in certain situations it does not seem to have much influence in this situation where most of the moves are made from school to school of a closely coordinated city system.

In the present analysis it was found from a study of an approximately normal group of 212 cases that those who had made more than the average number of moves were retarded for an average of .1896 terms beyond their actual IQ expectancy. This was compared with an average retardation of 2.190 terms for this group of retarded pupils and by the method of the normal curve described on page 38 was found to account for about 0.4 per cent of the total cases of retardation. Again one cannot be sure that this is all a relationship in which the number of changes of schools influences the rate of progress, because there is a possibility that in some cases the casual relationship worked in the reverse direction.

The actual coefficient of correlation between changes from school to school and rate of progress with IQ held constant was $-.19 \pm .05$[26] when corrected for the attenuation of the rate of progress.

Counselor's Ratings of Home Conditions

Total Home Conditions

In an effort to find the total influence of home conditions on rate of progress, the counselor in one of the schools was asked to

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[24] The over-age pupils made up an average of approximately one and one-quarter terms, while the under-age pupils lost an average of approximately three-quarters of a term.

[25] Gwinn: "The Influence of Changing from School to School in School Progress of Children." Finds that one or two moves loses one year, while three or four moves loses a year and a half.

[26] Bi-serial correlation.

rate the total home influence of those students in the 8B classes with whose home conditions she was sufficiently familiar to be able to form what she regarded as a reliable estimate of them. The rating was entirely subjective on a five-point scale in which the middle point represented the average home condition of the neighborhood in which the school was located. The counselor had had a great deal of experience in visiting homes and was quite familiar with the general home conditions in that neighborhood. She checked over each of the ratings a second time before they were sent in to be recorded on the data sheets.

Forty-six of the cases so rated were available for comparison with the rate of progress and the IQ. The corrected sigmas are shown in Table 29.

TABLE 29

TOTAL HOME CONDITIONS

SIGMAS OF RATE OF PROGRESS, IQ AND HOME CONDITIONS

	TOTAL 961 CASES	THIS GROUP 46 CASES
Progress	1.803 terms	2.181 terms
IQ	11.635 points	12.465 points
Home conditions		.850 units of 5-point scale

The raw correlations corrected for coarseness of grouping are shown in Table 30.

TABLE 30

TOTAL HOME CONDITIONS

CORRELATIONS FOR 46 CASES

	TOTAL 961 CASES	THIS GROUP 46 CASES
Progress and IQ	.680	.675
Progress and Home Conditions		.241
IQ and Home Conditions		.312

Where the reliability of the rate of progress rating is taken as .60 and the multiple correlation factor for IQ is taken as .825 (as in Chapter III, page 27) the coefficient of correlation between home conditions and rate of progress with the effect of IQ partialled out becomes slightly negative when the reliability of the ratings of home conditions is assumed to be such as may be expressed by any value of a coefficient of correlation from .40 to .80.

From Tables 29 and 30 it may be seen that the group of 46 cases was about comparable with the original group of 961 cases. The allowance for the reliability rating, from a coefficient of .40 to one of .80, is ample to take care of any reasonable value for the reliability of the ratings for home conditions. It may be said, therefore, that for this average group the home conditions do not show any relation to the rate of progress except inasmuch as they reflect the IQ of the pupils.[27]

Physical Home Conditions

A second attempt to find a relationship between home conditions and rate of progress was made by a comparison of rates of progress with the ratings given for the physical home conditions by the same counselor and under the same conditions as previously outlined for "Total Home Conditions".

This group was composed of 47 cases. Thirty of them were the same cases studied in the correlation with ' Total Home Conditions". The correlations between IQ and rate of progress and between IQ and home conditions were identical with the correlations found for "Total Home Conditions". The coefficient of correlation between physical home conditions and rate of progress (corrected for coarseness of grouping) was .060. When the effect of intelligence is partialled out this coefficient of correlation between physical home conditions and rate of progress becomes negative. The exact value of the partial coefficient

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[27] It is interesting to note that the coefficient of correlation which will express the relationship between rate of progress and IQ when the effect of home conditions is partialled out is about one per cent lower than the first order coefficient expressing this relationship.

was not calculated.[28] About all that can be said is that after the influence of intelligence has been removed there is a negative correlation left between physical home conditions and rate of progress for these 47 cases.

Effort on the Part of the Pupil

Teachers' Estimates

In the elementary schools separate ratings are given for "Effort" and "Conduct", while in the junior high schools these ratings are combined into one called "Cooperation". When the original records were copied from the individual record cards the "Cooperation" marks were copied for the junior high school cases and the "Effort" marks for the elementary school cases. These were correlated with the number of failures in the 7th and 8th grades, and with the IQ's of the pupils.[29] For purposes of this correlation the pupils were grouped into three failure distributions. One group comprised those students who had perfectly clear records, that is those who had no failures in major subjects[30] in the 7th or 8th grades and who were not more than 14 years of age and who had made normal or better than normal progress since their entrance to grade 1A. The second group included those pupils who had a total of one or two failures in major subjects in grades 7 and 8. The third group included those pupils

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[28] In the first place the correlations between rate of progress and home conditions and between IQ and home conditions are not high and are not very reliable. In the second place the coefficient of correlation between rate of progress and IQ is very high. With this situation it is very easy for a slight variation in one of the coefficients to make a very great difference in the partial coefficient.

It will be recalled in this connection that the partial correlation technique was used when considering the relationship between the rate of progress and "Total Home Conditions." But in the case of "Total Home Conditions" the coefficient of correlation between home conditions and rate of progress was much greater. But more important still is the fact that the partial coefficient obtained was smaller numerically than the raw coefficient, and in such cases the possibility of great variation is comparatively slight.

[29] The coefficient of correlation between the criterion "Rate of Progress" and the number of failures in 7th and 8th grades was found to be .51 for 191 representative cases. Corrected for attenuation this coefficient would be about .75.

[30] The major subjects were: English, History, Mathematics, and Geography or Science. (Foreign Language or Commerce in 8B was not counted.)

who had three or more failures in major subjects. In about 800 of the cases the IQ used was the average of the Otis IQ and the Otis equivalent of the Philadelphia IQ. In the remaining cases the Otis IQ was used alone. The raw coefficients of correlation are given in Table 31.

TABLE 31

CORRELATIONS BETWEEN EFFORT, SUCCESS, AND IQ (1177 CASES)

Effort and success	.575
IQ and success	.528
IQ and effort	.303

The general bases of these correlations are, of necessity, determined from the records of about two years of the pupil's school life, while most of the other correlations in the study are based on records covering eight or more years. Hence it is not possible to compare these values directly with most of the others found in the study. While theoretically it is a very simple matter to correct a coefficient of correlation for change in heterogeneity, there are so many complications in this particular situation that it is not practical to do so. It will be remembered that for the situation where the records covered eight or more years, the most likely value for a coefficient of correlation which would express the true relationship existing between true IQ and true rate of progress was chosen as .966. It is now seen that these "Effort" marks correlate even more closely with success than do the IQ ratings. It may be said, therefore, with a good deal of confidence that the teacher's estimate of the pupil's effort correlates very highly with the pupil's rate of progress. For the two-year range, it is in the neighborhood of .80 when it is corrected for the unreliability of the teachers' marks and the IQ ratings. For the eight-year range of progress it is probably above .90. Due to the relatively low coefficient of correlation between effort and IQ, this coefficient of .90 would be increased rather than decreased by partialling out the influence of IQ.

It is not likely that the rate of progress influences the IQ to any

great extent,[31] while it is decidedly likely that the rate of progress influences not only the pupil's effort but also the teacher's estimate of that effort. Thus while the high degree of relationship existing between IQ and progress is to be regarded almost wholly as one in which the IQ influences the rate of progress the degree of relationship existing between the teacher's estimate of effort and the rate of progress, which may be equally high, must be regarded only partially in the light of a relationship tending to influence the rate of progress.[32]

TABLE 32

RELATION OF THE EQ TO THE IQ FOR A SUCCESS GROUP AND A FAILURE GROUP

SUCCESS GROUP

IQ RANGE	MEDIAN IQ	MEDIAN EQ	AVE. EQ. EXCESS	EXCESS PER CENT OF CASES[33]	CASES	N TIMES EXCESS	PROBABLE EXCESS OF[34]
130–139..	130[35]	138[37]	8.00	100.0	1	8	EQ
120–129..	122	125[38]	1.88	57.4	60	113	EQ
110–119..	115	116	.93	56.7	130	121	EQ
100–109..	107	108	2.52	64.9	40	101	—
90– 99..	97[40]	101	5.37	73.7	19	102	IQ
80– 89..	86[41]	90	4.00	100.0	1	4	IQ
Total....	114.5				251	449	

Average EQ Excess = 1.79 EQ points

[31] See note 2, page 85.

[32] Let E = that part of "effort" which is not conditioned by IQ.
When $r_{\overline{PI}} = .80$, $r_{\overline{PE}}$ cannot exceed .60 (see footnote 48, page 55.)
$r_{\overline{PI}} = .90$, $r_{\overline{PE}}$ cannot exceed .44
$r_{\overline{PI}} = .95$, $r_{\overline{PE}}$ cannot exceed .31.

[33] The formula used to calculate the per cent of excess of EQ's over IQ's was:

$$\text{Per cent} = \frac{\text{Cases of EQ excess}}{\text{Total cases where IQ is not equal to EQ.}}$$

[34] The last column in this table, marked "Probable Excess of" has taken into account the factors discussed below and indicates that there is probably a slight positive relationship existing between IQ and excess of EQ, or in other words that the correlation between IQ and $\frac{EQ}{IQ}$ is slightly positive.

See Peters: "A Method for Computing Achievement Quotients on High School and College Level." (Gives correction for end effect.)

See Masden: "Intelligence and Accomplishment."
Correlation IQ and AQ reading—.77
Correlation IQ and AQ arithmetic—.42
Correlation IQ and AQ spelling—.08

[35] These values are too high due to the "end of a distribution" influence and to their excessive distance from the mean for their rate of progress. More accurate testing would probably lower these median values.

TABLE 32 (*Continued*)
RELATION OF THE EQ TO THE IQ FOR A SUCCESS GROUP AND A FAILURE GROUP
FAILURE GROUP

IQ RANGE	MEDIAN IQ	MEDIAN EQ	AVE. EQ. EXCESS	EXCESS PER CENT OF CASES	CASES	N TIMES EXCESS	PROBABLE EXCESS OF
120–129..	120[36]	121[39]	.60	77.8	10	6	EQ
110–119..	112[36]	111	−1.43	42.4	62	− 89	—
100–109..	103	103	−1.23	46.7	141	−173	—
90– 99..	94	94	.49	53.1	134	66	—
80– 89..	85	86	1.82	57.6	62	113	—
70– 79..	78[42]	81	6.68	73.7	19	127	IQ
60– 69..	60[43]	79	19.00	100.0	1	19	IQ
Total....	99.4				429	69	

Average EQ Excess = 0.16 EQ points

The Relation Between the EQ and IQ

As a check on this effort-progress relationship, the relationships existing between the scores made on the Achievement part of the Otis test with the scores made on the Intelligence part of the test, were examined. The EQ's determined by this test were compared with the IQ's for two groups of pupils. One group was the first group described in an earlier part of this section. It will be called the success group. The other group was the third group previously described, the group with three or more failures in major subjects in the 7th or 8th grades. It will be called the failure group.

Table 32 shows certain pertinent facts in regard to these two groups.

[36] *Ibid.*

[37] These values are too high when used in comparison with the IQ's because the highest mental age which could be scored with this test was 18.75 years while the highest educational age which could be scored was 23.3 years. About 50 students (in the whole study) scored educational ages above the maximum possible mental age.

[38] *Ibid.* [39] *Ibid.*

[40] These values are too low due to the "end of a distribution" influence and to their excessive distance from the mean for their rate of progress. More accurate testing would probably raise these median values. As a concrete illustration of the "end of a distribution" influence we may list the following facts:

82 failure cases. IQ below 90 Ave. EQ excess = 3.16
96 failure cases. EQ below 90 Ave. IQ excess = 5.77

This means that while the students who received the lowest average test scores show an EQ excess of 3.16 points when grouped on the IQ basis, when grouped on a basis of the average of their IQ's and EQ's they would probably show an IQ excess equal to (5.77—3.16).

[41] *Ibid.* [42] *Ibid.* [43] *Ibid.*

For a number of reasons (which have been explained in detail in the notes at the bottom of page 75) it is dangerous to draw conclusions from a comparison of cases in the success group with cases in the failure group unless these cases are near the median IQ's of their respective groups. The safest groups to study are the success group with IQ's from 110 to 119 and the failure groups with IQ's from 90 to 109. 130 such cases in the success group show an average EQ excess of 0.93 while 275 such cases in the failure group show an EQ excess of −0.39. The total difference between these groups is thus 1.32 points of EQ. One point on the EQ scale is equivalent, for the average part of the Otis scale, to two months of educational age. The 1.32 points are thus equivalent to about 0.22 years of educational age. The tendency toward retardation will be taken as one half of this difference, or 0.11 years. This is equal to .22 terms. This is about 11 per cent of the mean retardation of approximately 2 terms. On the assumption that the force of causes is proportional to the displacement produced by these forces, it might be said that this lack of living up to their IQ possibilities was 11 per cent responsible for the failure of the average case. But one has no right to assume that the failure was caused by this lack of effort. It is entirely possible that the lack of effort was caused by past experience with failure. These two opposite possibilities can be taken as limiting conditions. When the normal curve probability method (page 38) is applied to the situation where the factor under consideration is assumed to be 11 per cent of the cause of failure for the average case, it is found that the maximum possible casual relationship between lack of effort as measured by failure to live up to IQ possibilities is such that this factor is more than half responsible for about 1 per cent of all the failures. The minimum possible casual relationship is, of course, 0 per cent.

A summary of this section dealing with "Lack of Effort on the Part of the Pupil" would find that effort as measured by the teachers' estimates may be responsible for a moderate per cent of the failures and that effort as reflected by the relation of the EQ to the IQ may be responsible for from 0 per cent to 1 per cent of the failures.

Physical Condition of the Pupils

Absences

A study of the relation of the number of absences to the rate of progress of pupils was made for a representative school. It was found that 56 pupils in this school had had three or more failures in major subjects in the 7th and 8th grades, while in the same school 65 pupils had had no failures in major subject. The median number of absences per term (6.40 days) was identical for these two groups. The mean number of absences was greater, however, for the failure group. A study of the relationship table showed that there was no difference in the number of failures until the average number of absences per term reached 15.00. Beyond this point there were 4 cases of three or more failures, but no case of zero failures.[44]

An analysis was then made of all of the cases for which attendance records were available (about 1200 cases). It was found that 5 pupils who had no failures in major subjects in the 7th or 8th grades had average absences of more than 14.99 days per term. There were 27 cases of pupils who had three or more failures in major subjects and average absences of more than 14.99 days per term. There were 10 cases out of the basic 961 cases used for most of the relationships in this study where the absence in one or more terms was so great that the pupil was not given any rating for the term's work. The number of days of absence which would require a "No Rating" mark for a term is about 45. In some cases, however, the pupil is promoted on his past record when the total number of days absence exceeds this normal value (one half of the sessions in the term). The 10 cases above are listed in Table 33.

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[44]Keyes: "Progress Through the Grades of City Schools." Finds that absence of more than 25 days is factor in retardation.
Woodrow: "Brightness and Dullness in Children." Finds that absence of more than 30 days in a half year is almost sure to result in failure.

TABLE 33
ANALYSIS OF 10 CASES MARKED "NO RATING" FOR ONE OR MORE TERMS

IQ	TERMS MARKED "NO RATING"	MAJOR FAILURES IN OTHER TERMS	RATE OF PROGRESS	NOTES
		(7A to 8B)		
115.....	1*	4	2 ret.	Other abs. 20, 47
112.....	1	0	2 acc.	
107.....	1	2	Normal	Made up by Summer School
106.....	1*	10	4 ret.	
106.....	1**	1	1 ret.	
105.....	2**	2	1 ret.	
96.....	2**	2	1 ret.	
93.....	1*	5	3 ret.	
92.....	1*	0	2 ret.	
81.....	1*	2 incl. 1 non-promotion	6 ret.	

It will be noticed that eight cases have been marked with asterisks (*). These are cases of retardation and constitute about 1.6 per cent of the total 497 cases of retardation. Two facts should be noted. The median IQ is below the point (111) below which the IQ has been assumed (see page 35) to exert a retarding influence, and most of the cases show serious failure in other terms. Thus it cannot be said that for these cases the chief influence in causing retardation has been the prolonged absence in one or more terms of the 7th or 8th grades. It has probably been the chief cause in the three cases marked with a double asterisk (**). On this basis one would assume that it has also been the chief cause for nine $(3x\frac{3}{2}-3)$ other cases in grades 1 to 6 inclusive.[45] This makes a total of 12 cases or 2.4 per cent of the total cases of retardation. It is fairly certain that prolonged absence (caused almost invariably by the illness of the pupil) has been responsible for about 2 or 3 per cent of the cases of retardation.

Returning now to the 32 pupils who had an average absence in the 7th and 8th grades of 15.00 or more days per term it is

[45] Some of these cases in grades 1 to 6 inclusive may have been some of the other cases in the above table, but the percentage relationship would not be changed by this fact.

found that there were 22 more pupils (27–5) in the failure group than in the success group. The median IQ of these 22 cases was about 99. The mean number of terms of retardation to be expected from the true regression line between IQ and rate of progress when the IQ is 99 is about 1.5. Thus until the retardation reaches 3 terms it may be assumed that the IQ is more than half responsible for the retardation of the pupils in this group. Of the 22 cases 5 had a retardation of three terms and 3 had a retardation of more than three terms. Thus it may be said that if this influence had been working on these pupils all the way up through the grades it would have been responsible for the retardation of about 5½ cases ($3+\frac{1}{2}\times 5$). In the total group of cases from which these 22 were taken, there were 666 retarded cases. 5½ is 0.8 per cent of this total. There is therefore no reason to believe, from the study of the cases with average absences of 15.00 or more in the 7th and 8th grades that the per cent found in the preceding paragraph, namely 2 or 3 is too low a value to assign to the part played by absence as a cause of retardation.

There is on the other hand some reason to believe that this value is too high. No matter what the other influences are, the pupil with an IQ sufficiently high will arrive at the end of 8B with an acceleration of at least one term. (See Table 8, page 29). It may therefore be assumed that some of the retardation due to absence will be made up in the cases where the IQ is moderately high and that the total number chosen ($17\frac{1}{2}=12+5\frac{1}{2}$) will be decreased by the time the end of the eighth grade is reached.

Physical Defects

Evidence has already been found that the physical condition of the pupils as reflected by instances of prolonged absence due to illness is responsible for a certain amount of retardation. The question naturally arises as to whether poor physical conditions are responsible for cases of retardation in instances where they do not induce prolonged absence. Some indications of poor physical conditions may be poor vision, under-weight conditions, or organic disturbances such as thyroid, heart, tonsil or dental defects, etc. While it is evident that all of these conditions cannot be detected from the records which are available, the influence

which is exerted in the cases for which definite information is available can be studied. It may also be inferred from the fact that the school system provides for frequent and systematic medical inspection of all of the pupils that most of the serious cases would be detected and recorded on the cumulative medical inspection cards which were examined for all of the cases in this study.

A study of the medical records of the 961 cases is summarized in Table 34.

TABLE 34

PHYSICAL DEFECTS AND RATE OF PROGRESS

MEDICAL CARD RECORD	NO. OF CASES	RATE OF PROGRESS[46]
Defective tonsils	97	Slightly above normal[47]
Underweight	107	Very slightly above normal
Stooped shoulders	40	Very slightly above normal
Speech defects	8	Very slightly above normal
Dental defects	290[49]	Very, very slightly above normal
Heart defects	13	Normal
Defective hearing	3	Normal
Nervousness	2	Normal
Anemia	2	Normal
Defective vision	97	Slightly below normal[48]
Nasal Obstructions	15	1/3 term below normal[50]

From one school, with a total of 212 cases and an approximately normal distribution of IQ's and rates of progress, we have available the records of pupils in speech and nutrition classes. These records are given in Table 35.

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[46] The rate of progress is compared, for each IQ group, with the actual mean rate of progress of that IQ group for all of the cases.

[47] Pupils with defective tonsils are more accelerated than pupils with defective vision are retarded. Pupils with defective vision are retarded on average of about 1/10 term beyond the normal for their IQ's.

[48] *Ibid.*

[49] In the cases of dental defects only those cases are recorded where the medical card showed no record of the correction of the defect. For all other physical defects the cases were recorded in this table regardless of whether or not the medical cards showed records of the later correction of this defect.

[50] This is not sufficient to account for any cases of retardation.

TABLE 35
SPECIAL-CLASS RECORDS FOR ONE SCHOOL

	CASES	RATE OF PROGRESS[51]
Speech class	29	Very slightly above normal
Nutrition class	9	Very slightly above normal

From an analysis of these tables, the inference may be drawn that such physical defects as are noted on the medical inspection cards do not play any part in causing retardation. Reasoning by analogy it may be inferred that it is likely that no physical defects, at least of the readily identificable type, play any great part in causing retardation. The rates of progress of the pupils who have these various physical defects is so slightly different from the normal rate of progress that it is not safe to say that one defect is any more of a cause of rapid or slow progress than another. Thus it cannot be said from this study that defective tonsils aid progress and defective vision retards it.[52]

It is interesting to note that all of these physical defects are distributed approximately normally as far as the IQ's and the rates of progress are concerned.

Physical Education Records

As a further check, the physical education records were examined for one school (212 cases with normal distributions of IQ's and rates of progress). The results are shown in Table 36.

TABLE 36
PHYSICAL EDUCATION RECORDS FOR ONE REPRESENTATIVE SCHOOL

	CASES	RATE OF PROGRESS
Underweight	33	Very slightly above normal
Overweight	17	Very slightly above normal
Average of less than "Fair" in five apparatus events	33	Normal
Average of less than "Fair" in three track events	68	Very slightly below normal

[51] This rate of progress is in comparison with the mean rate of progress for a given IQ in both this school itself and in all of the schools in the study.

[52] It will be noted that defective vision is the chief factor which shows, by these figures, a tendency to retard progress. By the normal distribution method previously used under similar circumstances it is found that even if this relationship is a true one, and not due, as is indicated by the rest of the table, to chance errors in the sampling, it will not account for a single case of retardation.

This last table simply confirms the previous tables, so that it can be said that there appears to be no relationship whatever between the physical condition of the pupils and the rate of progress in school unless this condition is such as to cause prolonged absence from school.

Summary

Sex

There seems to be a sex factor in retardation, although its total influence is probably almost negligible. The girls make better progress in comparison with their IQ expectancy than do the boys. The coefficient of correlation, $.26 \pm .02$, is significant, but is not high enough to account for as much as one per cent of the total cases of retardation.

Factors Related to Home Environment

Home environment does not seem to be a factor in retardation except inasmuch as it reflects the IQ of the pupils. The factors of foreign parentage, reading quotients and studying in a room by oneself seem to have a positive relationship to the rate of progress, and the factors of changes from school to school and planning to go to work seem to have a negative relationship to the rate of progress. The other relationships are not large enough to be significant or else they are not reliable. In no case is the relationship large enough to account for as much as one per cent of the total cases of retardation.

The actual correlations found are listed in Table 37.

Effort on the Part of the Pupil

Lack of effort, as indicated by the teachers' estimates of effort, is very closely related to failure in the major subjects but we have no way of knowing the exact extent to which this relationship is one in which the lack of effort affects the rate of progress. Lack of effort as reflected by the relation of the EQ to the IQ is only slightly related to failure.

TABLE 37

SUMMARY OF CORRELATIONS FOUND FOR HOME ENVIRONMENT AND THE RATE OF PROGRESS[53]

The decease of one or both parents	+.06 ± .04
Foreign parentage	+.26 ± .02
Reading quotient	+.25 (Not reliable)
Occupations of the fathers	
Managerial or professional service	−.02 ± .05
Laborer or personal service	+.10 ± .06
Future plans of the pupils	
College	+.04 ± .03
Normal school	+.08 ± .04
High school only	+.07 ± .03
Work	−.37 ± .04
Studying in a room by oneself	+.11 ± .02
Number of other children in the family	+.0
Age at entrance to the first grade	(Not calculated)
Changes from school to school	−.19 ± .05
Total home conditions	−.0
Physical home conditions	−. (Not reliable)

Physical Condition of the Pupils

Cases in which absence is due to illness probably account for about two or three per cent of the total cases of retardation. Physical defects or the condition of the pupils as reflected from the physical education records seem to have no relation to the rate of progress.

Conclusions

It is probable that poor health accounts for 2 or 3 per cent of the total cases of retardation and that other factors of sex or home environment account for another 2 or 3 per cent of the total cases of retardation. If lack of effort, as reflected by the relation of the EQ to the IQ is to be regarded as a cause of retardation it may be regarded as responsible for 1 per cent of the total cases of retardation. It seems reasonable to say that at least 5 per cent of the total cases of retardation are due to causes other than the IQ.

[53] In all cases the IQ of the pupils has been held constant.

V

Conclusions

In this study an attempt has been made to find the factors[1] which are most closely related to the rate of progress of the pupils from the time of entrance to grade 1A to the time of completing the 8th grade. It has been studying, in particular, the relationship between the factor called "Intelligence" and the rate of progress. A summary of the conclusions reached in Chapters III and IV shows that the factor called "Intelligence" has a very definite relation to the rate of progress, and that the factor of poor health has some relation to the rate of progress. Sex and some factor connected with the parentage of the pupils has a measurable relationship to the rate of progress. Due to the intangible nature of the factor called "Effort" it was very difficult to determine the relation existing between this factor and the rate of progress. There seems to be a certain relationship between the two, but it is impossible to tell whether the lack of effort influences the rate of progress or whether the rate of progress influences the amount of effort put forth. While the teachers' estimates of "Effort" show a very close relationship to the number of failures in major subjects, the relation of the EQ to the IQ indicates that it is not likely that this relationship could have accounted for more than 1 per cent of the cases of retardation. As has just been stated there is no conclusive reason for thinking that this relationship is one wherein the lack of effort is acting as a causal factor.

Table 38 shows the findings of this study in relation to the various factors studied.

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[1] Imperfect functioning of the machinery of failure caused about 20 per cent of the retardation. This factor is not a *cause* of failure, and therefore this 20 per cent was distributed among the other categories.

TABLE 38

THE RELATION BETWEEN THE RATE OF PROGRESS AND CERTAIN FACTORS

FACTOR	PER CENT OF THE TOTAL CASES OF RETARDATION IN WHICH THE FACTOR IS MORE CLOSELY RELATED TO THE RETARDATION THAN IS ANY OTHER FACTOR
Intelligence[2]	82 to 97[3]
Poor Health (Involving Absence)	2.5
Other factors such as inherited traits not measured by group intelligence tests, nativity of the parents, race, sex, changes from school to school, future plans of the pupils, studying in a room by oneself, lack of effort, factors for which the present study gives negative results and factors not studied in the present analysis	0.5 to 15.5[4]
Factors for which no relationship was found which would be great enough to account for any significant per cent of the failure, except inasmuch as it reflected the IQ of the pupil:	
Reading ability.	
Number of children in the family.	
Decease of one or both parents.	
Occupations of the fathers.	
Total home conditions (subjective judgments).	
Physical home conditions (subjective judgments).	
Absences of not more than 15 days per term.	
The physical condition of the pupils:	
Tonsils.	
Underweight.	
Stooped shoulders.	
Speech defects.	
Dental defects.	
Heart defects.	
Defective hearing.	
Nervousness.	
Anemia.	
Defective vision.	
Nasal obstruction.	

[2] It is possible that the IQ of the pupil is conditioned to a significant extent by factors such as home conditions, schooling, etc., although some recent studies do not find evidence that these factors affect the IQ in a very significant manner. (See National Society for the Study of Education.) In the present study the factor of schooling is approximately the same for all of the cases. The significant fact is that the IQ, no matter how conditioned, is very difficult to change.

[3] The most likely per cent was taken as 93. See page 37.

[4] Probably about 4.5 per cent.

It is possible that intelligence is the factor most closely related to the rate of progress in about 95 per cent of the cases of retardation. Even if intelligence as measured by group intelligence tests is the factor most closely related to the criterion in a smaller per cent of the cases of retardation, the type of the remaining factors indicates the possibility that at least a portion of them are inherited traits which could not be measured with group intelligence tests. Some of these factors might be muscular coordination, emotional balance, energy, rate of fatigue, and a host of others, all of which might have been conditioned by heredity. The factors of race, nationality and sex are likewise prenatal, at least. Even if it is assumed that a fair proportion of the failure, perhaps 5 to 10 per cent is due to lack of effort, it must be realized that this lack of effort may be to a large extent conditioned by inherited characteristics. The lack of effort which is due to other than inherited characteristics may in turn be conditioned to a large extent by factors over which the individual pupil has no control. One is thus forced to the conclusion that a very small proportion of the cases of retardation found in this study were closely associated with factors over which the pupils could have exerted even the slightest control.

The reader should pause at this point, however, to remember that by retardation is meant the balance between success and failure when evaluated over the range of eight or more school years. It is not meant that the effort which it is within the power of the pupil to increase or decrease does not have any influence on his progress from day to day or even from term to term, but that this effort does not seem to have any appreciable influence on the sum total of his rate of progress when the progress through eight or more school years is considered. The broad generalization which these findings forces upon one is the statement that insofar as these findings are accurate it seems to be true that given the same type of instruction and marking, no amount of effort on the part of the pupil, or, for that matter, of the teachers, can be expected to have any significant influence on the rates of progress of the individual pupils. If one had all the necessary information

about each child available at the time of his entrance to grade 1A the estimate as to his rate of progress from grades 1A to 8B would be in error only slightly more than instances of prolonged absence due to poor health and chance variations in marking and promoting threw it out.

VI

Implications of the Study

It has been seen in the preceding chapters that there was one factor which was so closely related to the rate of progress through the first eight grades that it overshadowed all of the other factors combined. This factor was the Intelligence Quotients of the pupils. The factor of ill health was also slightly related to the rate of progress. It was very seldom that any case of retardation could not be accounted for by factors over which the pupil could not exert any influence. When the cases of serious retardation were considered, it was even more difficult to find a case which could not be explained on this basis.

The Teacher's Attitude Toward the Failing Pupil

The first implication has to do with the attitude of educators in general and of teachers in particular toward the pupils who fail. Very few teachers realize that the pupil is practically never to blame for a case of serious retardation. There are two reasons for this. In the first place the teachers do not know the exact mental and physical prenatal or environmental abilities and handicaps of their pupils, and in the second place they do not differentiate with sufficient accuracy between the serious cases of retardation which are closely associated with a lack of mental ability and the fairly frequent cases of incidental failure which may be due to temporary lack of effect or other causes more or less within the control of the pupil or the school. They do not realize that these latter failures will in all probability be counterbalanced at a later date by a little extra effort on the part of these pupils. Due to this lack of accurate information about each pupil and to this confusion of serious retardation with temporary failure many teachers fall into habits of treating failures which must have well nigh disastrous results. But they do not observe these unfortunate results because the pupils concerned are already failures and a little more failure is not particularly noticed. For instance, they tell pupils that "It is effort which counts,"

that "The proper thing is to choose some goal and work toward it" and that "Proper methods of study and concentration will insure success in school work." It is not likely that any of these things has the slightest real influence on the ultimate rates of progress of the pupils. But the fact that the pupils accept these statements as reasonable, and therefore as true, leads to attitudes of loss of confidence in themselves when they fail. Not only do teachers heap imprecations on the heads of the failure pupils, but they threaten them with failure at every turn. A recent article in "Children, the Magazine for Parents" suggests the futility of trying to teach a child to balance himself by asking him to walk upon the top of a high fence and then crying out each moment a warning that he is likely to fall, and that if he does fall the consequences will be little short of fatal.

The remedy for this situation lies in making the teacher acquainted with the true mental ability of each of his pupils. This means that he must have available a very accurate determination of the IQ of each pupil. He must also know the home situation and any special information about the pupil's physical condition which it is within the power of the school authorities to obtain for him. He must be provided with simple devices for filing this information and he must be trained in the efficient use of these devices. When the teacher has been provided with this information and has been trained in its use, he will not be likely to confuse the cases of serious retardation due to lack of ability with the cases of temporary failure due to other causes.

Adaptation of the Course of Study to the Abilities of the Pupils

The hindering influence of discouragement has just been discussed. The helpful influence of encouragement has been stressed by educators for a great many years. Nothing succeeds like success. It is necessary to provide each pupil with a school environment wherein he can succeed. This involves changes in the courses of study to meet the needs of the pupils of limited abilities. The question is too complicated to be discussed in detail in this study, but certain warnings may be given. For instance, the pupils with limited ability are frequently assigned to courses

which consist largely of English, Science, or Commercial subjects. The writer has found considerable evidence in various studies that success in these subjects correlates to a much higher degree with the IQ's of the pupils than success in subjects such as Latin and other foreign languages, Mathematics (except Algebra), and History. This means that it requires a high degree of intelligence to be successful in English, Science or the Commercial Subjects. This is particularly true in the Commercial field, where a high degree of intelligence is not only required in school but also in the profession after leaving school. It is not the intention here to suggest that the pupils with limited ability should be placed in the classical curriculum in the high schools or prepared for this curriculum in the lower grades, but it is implied that very careful study should replace much of the guesswork which has determined so often in the past, the correct methods of adapting the courses of study to individual abilities.

In this connection, one should consider the common situation in which the courses for the high ability groups are "enriched" Is it not as important to "enrich" the courses for the low ability groups? While for the high ability groups, the courses may be enriched by depth of thought, expression and reasoning, for the low ability groups they may be enriched by vividness of sensory and emotional appeal. The work for these groups should be anything but the bare, dull "minimum essentials" which are left in the course after the interesting things have been taken out.

Grouping on the Basis of Mental Ability[1]

It would not be wise in this study to venture upon the question of the advisability of sectioning pupils on the basis of mental ability. It may be interesting to note, however, that an analysis of 212 cases in grade 8B indicated that as far as predicting failure was concerned the "IQ" was nearly twice as accurate a criterion as the "Mental Age".[2] When pupils (or at least those of the

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[1] The following coefficients of correlation throw some light upon the relative values of the Otis IQ and EQ for this purpose. For 212 cases $r_{Fail.\ IQ} = -.50$, $r_{Fail.\ EQ} = -$, 49 and for 170 other cases $r_{prog.\ IQ} = .63$, $r_{prog.\ EQ} = .53$.

[2] Where

F = Failures
I = IQ
M = Mental Age

$r_{IF} = -.50$
$r_{FM} = -.38$

$\sigma_F = 1.000\sigma_F$
$\sigma_{F.M} = .925\sigma_F$
$\sigma_{F.I} = .866\sigma_F$

upper grades) are grouped within a given grade on the basis of IQ the groups will probably be more homogeneous as far as chronological age is concerned than when they are grouped on the basis of Mental Age.

Whether or not the pupils are grouped according to ability it is essential to know their IQ's with a high degree of accuracy. The results from one or two group tests of mental ability are not to be relied upon. If it were necessary to spend each period of each day for a whole term in order to find the true IQ, and if the different groups thus found were given properly differentiated work to do, time would be saved in the long run for practically every pupil in the school system. It is not suggested, however, that such an intensive testing program is actually necessary. It might be satisfactory to give some very thorough tests when the child enters the school system and then test again about once a term. In this way a cumulative score of great accuracy would be built up.

Adaptation in Methods for the Pupils of Limited Abilities

A great deal of experimentation needs yet to be done in this field. It will probably be necessary to give these pupils a much greater constancy of encouragement and a much greater definiteness of task than is necessary for the pupils of high abilities. One caution might be given. The intelligence of the average teacher is so much nearer the average intelligence of the higher groups of pupils that it will always remain a difficult task for him to understand the mental processes of the pupils of limited ability.

Discipline Problems with the Pupils of Limited Abilities

One fact that must be faced is the difficulty which will be experienced at first in handling these low ability pupils. It will probably be found that the present way of doing things has built up, during the past years of the pupil's school life, complexes of lack of confidence, laziness, and wrong attitudes toward the school and the teachers which cannot easily be modified. It may be that one cannot expect to do a great deal with the pupils now in the upper grades, but this is no indication that these complexes

cannot be avoided in the future if the differentiation is begun in the kindergarten or the first grade.

Guidance or Counselling Work

A very great extension of this type of service is demanded because of three facts. In the first place there exist at present numerous misunderstandings between the teachers and the individual pupils. In the second place some of the disabilities of the pupils are associated with their home conditions. And finally so many of the cases of low mental ability are associated with conditions of unfortunate home situations.

The Cost of Eliminating Failure

The financial cost of this program is not great. About the only added cost would be for the intelligence tests and certain new books and types of equipment, and for the providing of more school counselors.

The cost in terms of study and experimentation, however, may be great. But an adequate system of providing for this study and experimentation could be organized by school administrators so that duplication would be minimized and so that the results of the various experiments might be distributed as widely as possible.

The Possibility of Eliminating Failure

If pupils were retarded because teachers were not adequately trained, because the courses of study did not appeal to the pupils, because the pupils did not exert themselves or because of irregular attendance, the situation would be hard to change and the outlook would not be very hopeful. But if, as this study seems to indicate, the major portion of the retardation is due to the inability of the pupils to master the work given them, a change in the type of work required of them ought to remedy the situation. There is no reason why 90 per cent or more of the retardation cannot be eliminated in a few years. If the percentage of promotion has been 90 it may be raised to 99 by eliminating the non-promotions of these pupils.

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